WASHINGTON, D. C.
1910

AMERICAN BREEDERS MAGAZINE

Published by the American Breeders Association

Heredity of Feeble-Mindedness
HENRY H. GODDARD

The Mule-Foot Hog
W. J. SPILLMAN

Breeding Nut and Forest Trees
GEO. B. SUDWORTH

Breeding for Type of Kernel in Wheat
HERBERT F. ROBERTS

Breeding Drought-Resistant Cereals
ROBERT GAUSS

Report of Committee on Animal Hybrids

Third Quarter — July, Aug., Sept.

Vol. I — No. 3

Entered as second-class matter June 10, 1910, at the Post Office at Washington, D. C., under the Act of July 16, 1894

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Membership: Annual, $2.00; Life, $20.00; Patrons, $1,000.

The American Breeders Magazine

Published Quarterly by the American Breeders Association

FOR THE USE OF ITS MEMBERS

PRICE OF SINGLE COPIES, FIFTY CENTS

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JOSEPH GOTTLIEB KOELREUTER.

THE AMERICAN BREEDERS MAGAZINE

"Speaking of all the generations past
To all the generations yet to come."—J. G. HOLLAND.

Vol. I. Third Quarter, 1910. No. 3.

KOELREUTER, BAKEWELL, AND RIMPAU.

Koelreuter has a place of honor as the first breeder to hybridize plants. Bakewell is in a class by himself among the early pioneers in originating the British breeds of livestock. Rimpau was first among the German breeders of cereal crops. Each of these men gained not only prominence among their contemporaries, but also a place in the history of breeding. It seems strange that the inspiration instilled by the work of Koelreuter did not earlier lead to investigations along practical lines in making hybrids. Bakewell's example in forming new breeds, on the contrary, was followed by many men and many communities in forming new breeds of domestic animals.

JOSEPH GOTTLIEB KOELREUTER.
1733-1806.

Joseph Gottlieb Koelreuter received an intellectual endowment from his father, who was a chemist at Sulz on the Neckar, in Württemberg, Germany, In 1748 he entered the University of Tübingen, a very small German institution noted for the famous men it had put forth. He received the degree of Doctor of Medicine in 1756 and was soon called to a position in the Imperial Academy of Science at St. Petersburg. Here he had charge of the extensive collections of the Academy; here he published his observations on the sexuality of plants, and it was here that he accomplished the first artificial hybridization of plants of which botanists have record.

Koelreuter left Russia in 1761 to take the professorship of natural history at Calw, and in 1763 he was made "director of the gardens" of the Margrave Karl Friedrich at Karlsruhe, which for that time had a remarkable collection, the catalogue showing more than two thousand different species of plants.

The interest in his work was increased by the fact that the Margrave, and also his wife Margravine Karoline Louise, were botanists of some attainments and were also in close touch with Linné and other noted scientists of that day. Koelreuter's presence aided in making the Margrave's gardens a noted scientific center and place of pilgrimage, and much of the botanical work was made to relate to farming for the purpose of promoting the agricultural welfare of Württemberg.

These activities eventually led to the organization of an agricultural society by the Margrave, with Koelreuter as its most active member. The records of the society, which are still preserved, show that he outlined among many other experiments a series of trials with manures and fertilizers in which the plans used were much the same as those used in the plot experiments of the experiment stations of the present day.

ROBERT BAKEWELL.

1725-1794.

Robert Bakewell was the first of those great creative breeders primarily responsible for the origin of so many definite and valuable breeds of livestock formed in the British Isles. He was born at Dishley, Leicestershire, England, and began his breeding operations in 1755. Selecting his foundation from the native sheep of his own and surrounding countries, within his lifetime he transformed a coarse, late-maturing breed into one so early-maturing and so fat at a year old that the markets of the time considered them hardly edible. It is said that he secured some sheep from Lincolnshire to improve the wool of his sheep. To Bakewell is due much of the credit for having redirected the breeders of his time from breeding for size alone and to begin to breed for form, early maturity and long wool.

By selection and very narrow breeding he produced a flock or breed which served as a central source of prepotent or dominant blood that was a very potent factor in the formation and improvement of English long-wool and middle-wool sheep. Prices for males rose from several dollars to hundreds, and in rare instances to $5,000.

Some of Bakewell's contemporaries criticised a certain secrecy with which he shrouded some of his operations and business, but the probability is that his contemporaries did not understand the scientific work of Bakewell. Collections of bones and pickled parts of sheep

ROBERT BAKEWELL.

anatomy, together with his habit of keeping from view certain breeding animals, notably the "black ram," presumably furnished the neighborhood the material for gossip and for questioning his methods.

Bakewell also improved the heavy "Shire" horses of his county. He was also the first great improver of the Longhorn cattle, having sold the bull of that breed for $1,000. His impress was also placed upon the Yorkshire swine of the region. The animal forms molded by him a century and a half ago, and found today on the farms of every continent, are living witnesses to his genius.

No marble slab marks the burial place of Robert Bakewell. But his monument exists in the herds of those who are benefited by his skill as a scientific, practical, and, above all, successful breeder. Bakewell earned for himself lasting fame as a creative breeder. He truly was an originator. His peculiar service was in supplying potent material with which other breeders could work, and many improvers are carrying out the work for which he provided foundation material.

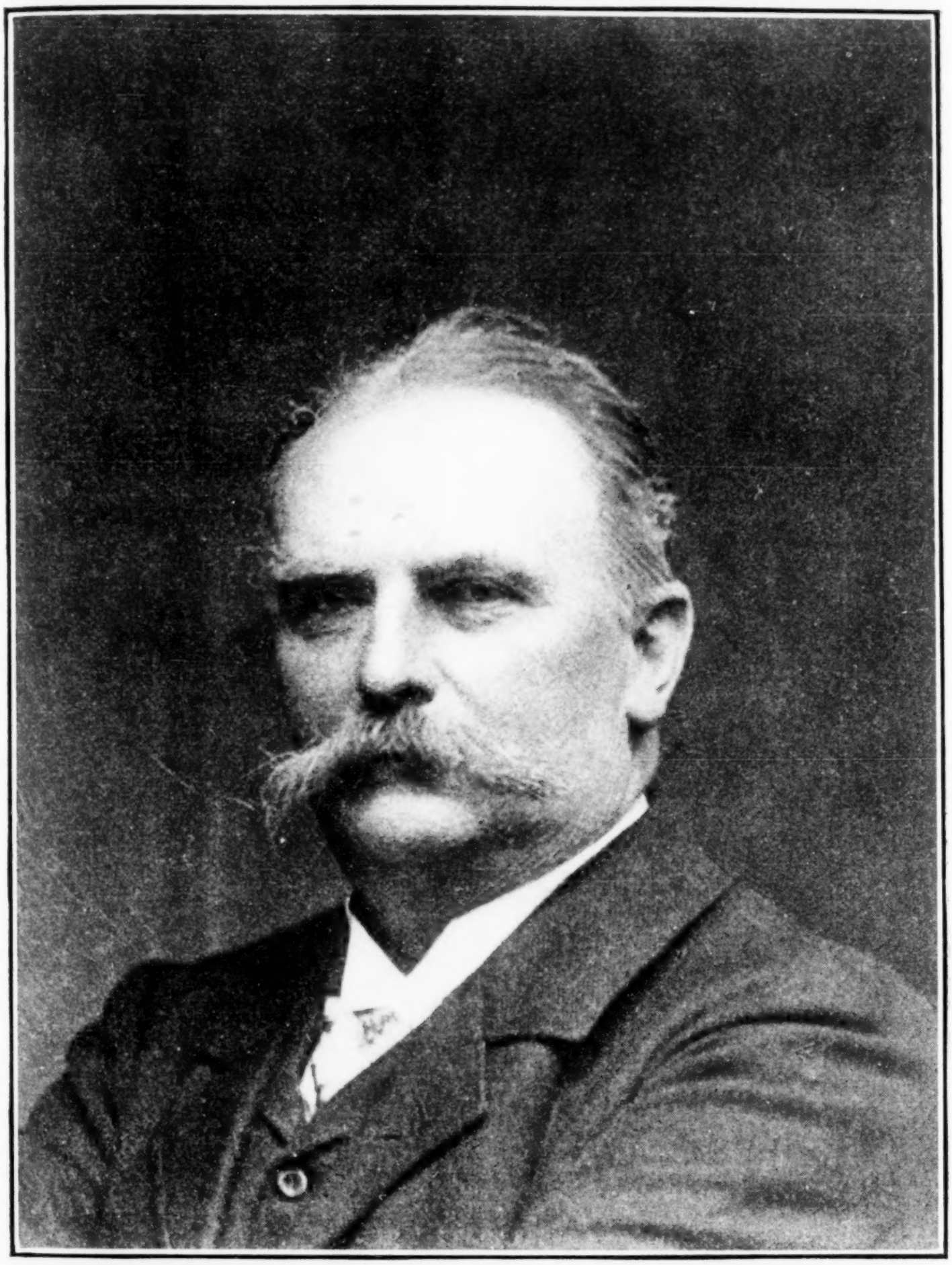
The portrait herewith is from an old print loaned the American Breeders Association by Mr. Richard Gibson, Delaware, Ontario, Canada, who furnished the facts in the above statement. Visitors to the Saddle and Sirloin Club, Stockyards, Chicago, enjoy seeing a portrait in oil painted from this original.

WILHELM RIMPAU.

1842-1903.

Dr. Wilhelm Rimpau was born at Schlanstedt, Germany. His father, Wilhelm August, was known as one of Liebig's most enthusiastic disciples and one of the very first to apply his teachings to practical agriculture. After graduating at the "gymnasium" or secondary school he spent two years of apprenticeship on the estate of Von Hoppenstedt at Liebenburg, to familiarize himself more widely with farm methods.

He then spent two years at the agricultural academy at Poppelsdorf and later took up university studies under the famous botanist, Julius Sachs. Returning to his father's estate, he soon became the sole tenant; and in 1892 came also in possession of the beautiful estate Langenstein, in the foothills of the Harz Mountains, where the present writer visited him in 1899. A large part of the area of the several



WILHELM RIMPAU.

thousand acres of these two farms was devoted to the production of seed crops, chiefly cereal and sugar beet varieties of Rimpau's own origination.

While his work in plant breeding extended to many cultivated crops, he devoted most attention to the breeding of new varieties of grain, chiefly rye. His method of breeding, which was largely wrought out with rye, would be termed in the more modern nomenclature "broad breeding." The German method of broad breeding of cereal grains is sometimes contrasted with the American and Swedish cent-gener method of narrow breeding. Dr. Rimpau's publications covered a wide scope in the fields of science, agriculture and economics. He had much to do in inspiring the modern movement in systematic plant breeding, and so far as the writer knows was the earliest German breeder of field crops to work in a broad and large way to create better varieties of those great products.

HEREDITY OF FEEBLE-MINDEDNESS.

HENRY H. GODDARD, *Vineland, N. J.*

The admission blanks of institutions for the feeble-minded generally have some questions relating to the ancestry of the applicant. Upon examination of those on file at Vineland, N. J., it was felt that the answers were not sufficiently accurate to be valuable. In some cases, at least, parents had stated that which they thought would get the child into the institution.

Recognizing the difficulty of preventing these inaccurate statements, it was decided to publish a new blank which should be called the "After-admission Blank," containing very careful, detailed questions about the relatives of the child. This blank was sent to all parents and physicians, with a little note urging them for the sake of the child to tell all they possibly could about the child's relatives, their condition, any diseases they had had, any habits, such as alcoholism, any insanity or the like which had occurred in the family. It was expected that this would only be preliminary to more detailed and careful work later. We were, however, greatly surprised at the amount of information received, which has since been proved to be generally very accurate. Upon the basis of this information, we prepared charts of the children, which were truly remarkable in what they revealed as to the etiology of feeble-mindedness.

This spurred us on to more careful and detailed work. We were fortunate enough to find some philanthropic people who were glad to furnish the funds necessary to employ two field workers. It was felt that this was very delicate business, but the relation between the superintendent at Vineland and the parents of the children is so intimate and friendly that we have had complete cooperation from the start. The field worker goes out as the superintendent's personal representative with a letter from him recommending her and urging the parents, for the sake of the child, to tell all they possibly can, and to send her on to other relatives or to any one who may be able to give the information, which may be used to help their child, or some one's child. The response has been full, free, and hearty. Parents do all in their power to help us get the facts. There is very rarely anything like an attempt to conceal facts that they know. Of course, many of these parents are ignorant, often feeble-minded, and cannot tell all that we should like to know. Nevertheless, by adroit

questioning and cross-reference, we have been able to get what we believe to be very accurate data in a very large percentage of our cases.

The charts here presented are typical of about eighty so far completed. The symbols used in the charts are the following: Square indicates male. Circle indicates female. A capital letter indicates disease, habit, or conditon, as follows: A, alcoholic (habitual drunkard); B, blind; C, criminal; D, deaf; Dwf, dwarf; E, epileptic; F, feeble-minded, either black letter, or white letter on black ground (the former when sex is unknown); I, insane; M, migraine; N, normal; Sx, grave sexual offender; Sy, syphilitic; T, tuberculous; W, wanderer, tramp, or truant.

Any of these letters may be used with no square or circle when sex is unknown. When even the letter is omitted the vertical line points to the fact that there was an individual of whom nothing is known.

Small black circle indicates miscarriage—time is given (in months) when known; also cause; stillbirth is shown as a miscarriage at nine months; b = born; d = died; m = married; inf = infancy; hand shows which child is in the institution for feeble-minded; illeg = illegitimate; heavy line under any symbol indicates that the person is in some institution at the expense of society.

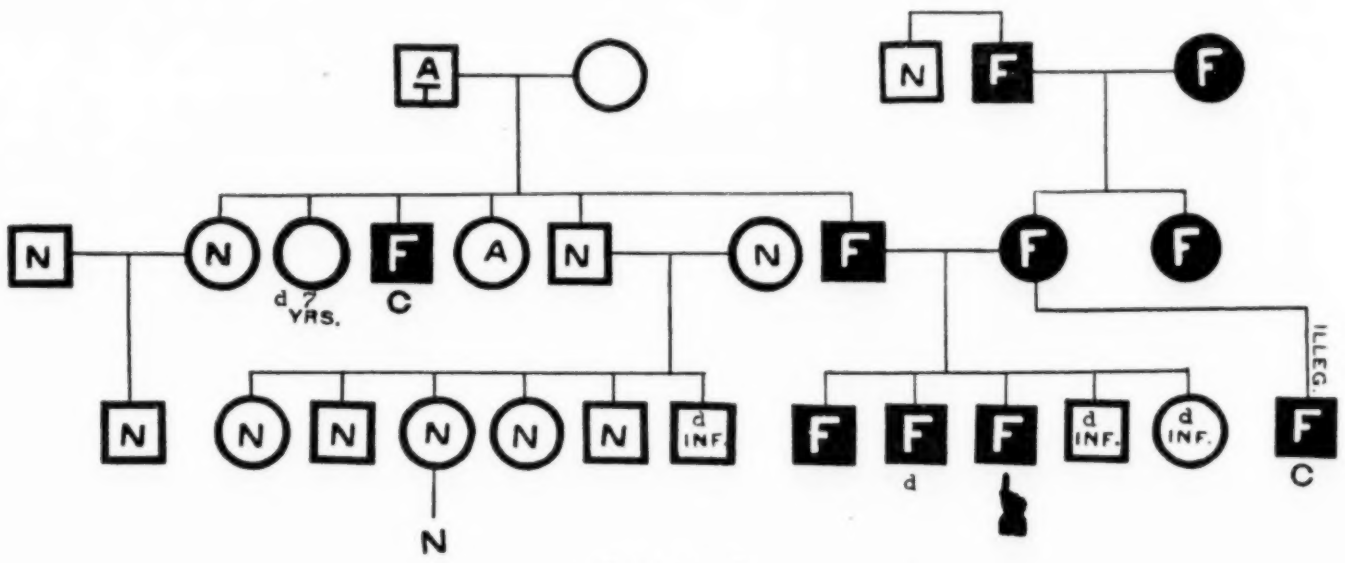


CHART I.

On the lowest line, which represents the brothers and sisters of the child in the institution, the children are indicated in order of birth—the oldest to the left. In other cases the order would be indicated, if known, by numerals placed above the horizontal line.

Chart I shows the maternal grandparents feeble-minded, and they have as usual only feeble-minded offspring—two girls. One of these married a feeble-minded man whose brother was feeble-minded and

a criminal, and whose sister was disgracefully alcoholic. However, a normal brother of the husband married a normal woman and had six normal children. The offspring of the feeble-minded woman and this feeble-minded man were three feeble-minded children and two others who died in infancy. An illegitimate child of this woman is feeble-minded and a criminal.

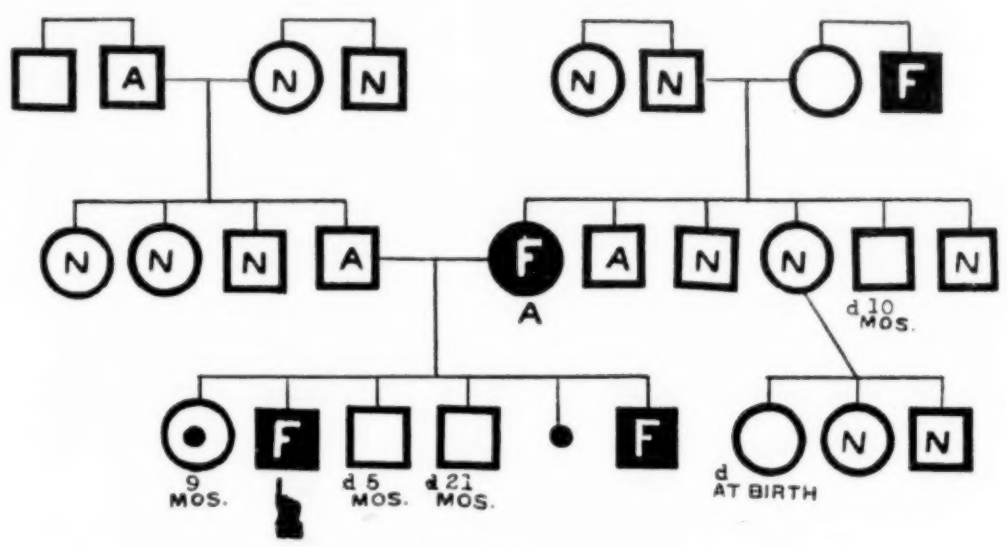


CHART II.

Chart II shows a combination of alcoholism and mental defect in the ancestry of the parents, resulting in alcoholism on the one side and direct feeble-mindedness with alcoholism on the other. The offspring of these two indivduals are all defective—one still-born, two that died young, one miscarriage, and two feeble-minded.

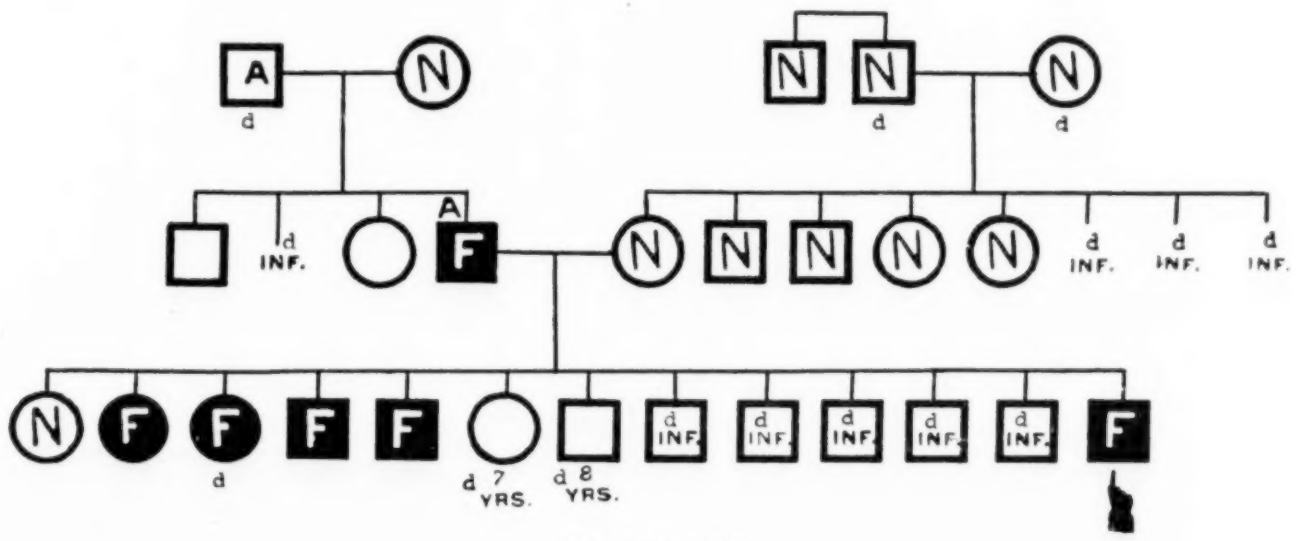


CHART III.

Chart III is instructive, in that it seems to show the effect of a combination of alcoholism and mental defect in the father, when the mother's family is good—herself and sisters being normal. The result of this woman's marriage with a feeble-minded alcoholic man is five feeble-minded children, five that died in infancy, two others that died before their mental condition could be determined, and one normal child. Apparently a clear case of transmission through the father.

Chart IV, also, seems to show the defect coming through the male, the grandfather, a feeble-minded man, marrying a normal woman, the result of this marriage being two feeble-minded children

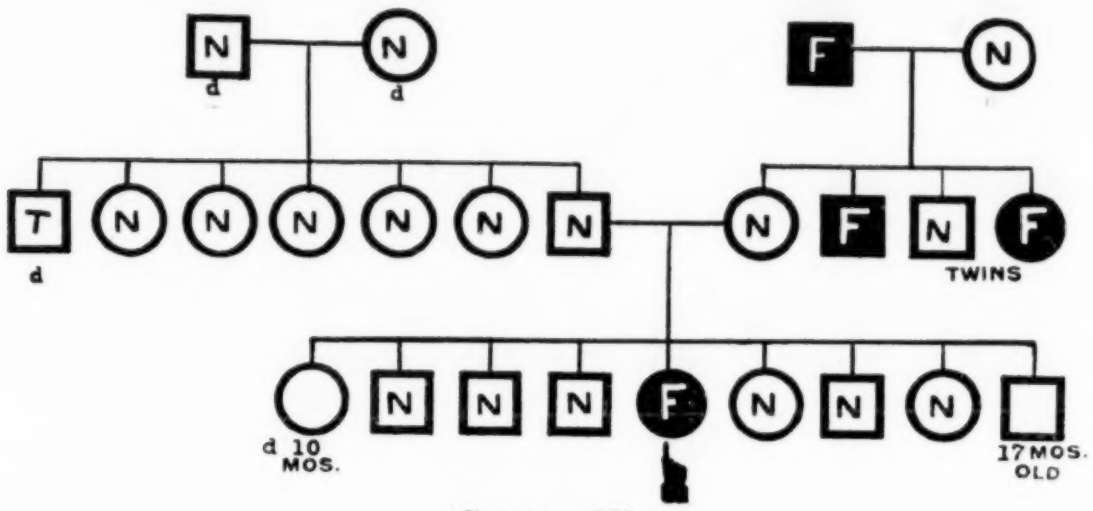


CHART IV.

and two normal ones. One of these normals married a normal man. They had six normal children, one feeble-minded, one who died in infancy, and one infant still living, but condition unknown.

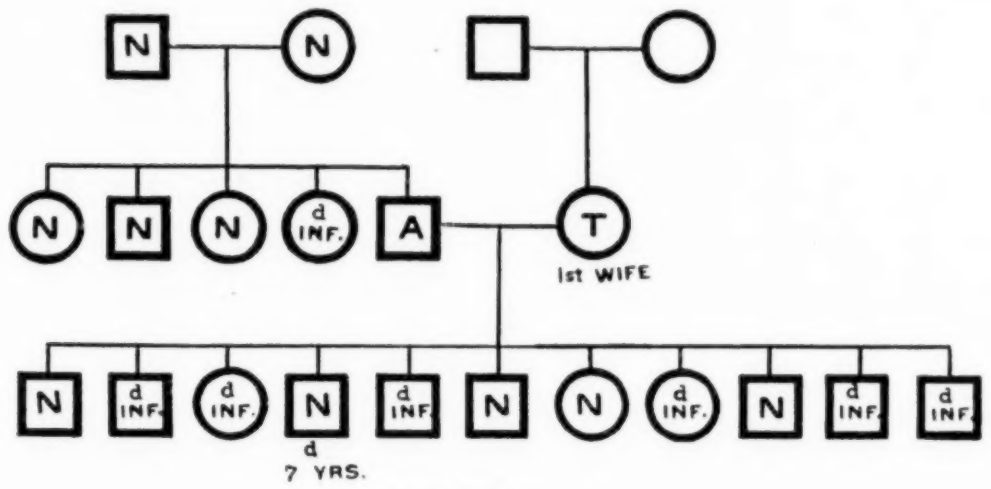


CHART V, *A*.

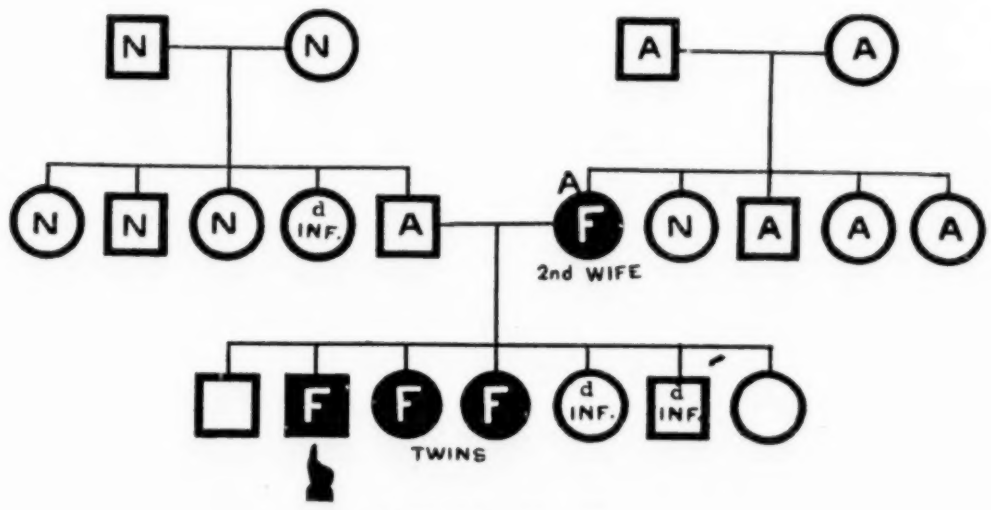


CHART V, *B*.

Chart V is presented in two parts—*A* and *B*. It gives us what may be called a natural experiment of extreme suggestiveness. The father of our child was twice married. He himself is alcoholic, otherwise his family seems to be very good. His first wife was a normal

woman, but a victim of tuberculosis. The result of that marriage was eleven children, of whom five are known to be normal, the others died young. This man married for his second wife a woman who was alcoholic and feeble-minded, and who had two sisters, a brother, a father, and a mother that were also alcoholic. The result of this union was seven children—three feeble-minded, two that died young, and two that are as yet unknown. It seems to be fairly clear in this case that the father's alcoholism may have caused the physical weakness that led to so many early deaths in the first family, but the mother's defect has been directly transmitted in the second family, with the result that there are at least three feeble-minded children. We might also add the two others that died young, because, according to the definition of Tredgold which describes an idiot as "one who cannot avoid ordinary dangers," these children were also defective, since they were both killed at play, apparently not being able to protect themselves in a usually harmless game.

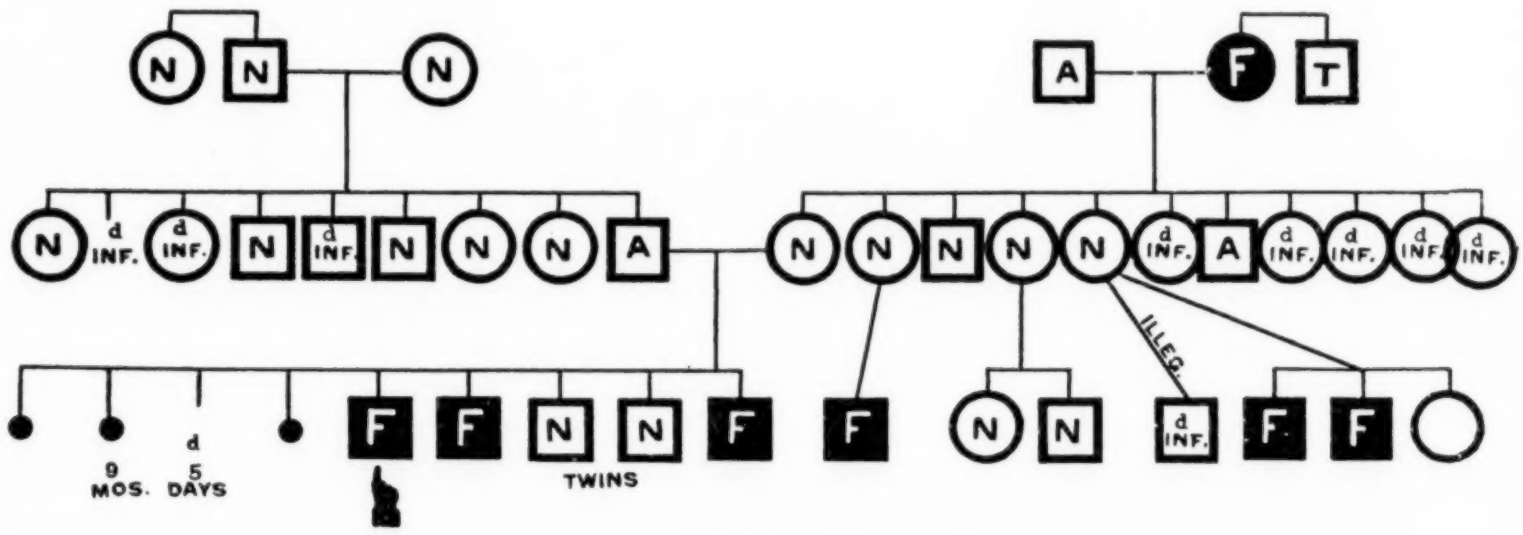


CHART VI.

Chart VI shows a marked instance of the defect skipping a generation. The maternal grandmother was feeble-minded, her husband was alcoholic, but not one of their children was defective. Indeed, four of them were distinctly normal. However, the mother of our child had had St. Vitus dance, a brother is alcoholic, a sister had had St. Vitus dance, and another hysteria, but mentally, they were not defective. The father has no history of mental defect in his family; he himself was alcoholic, but his five brothers and sisters and the parents were normal. Nevertheless the result of the union of these two is three feeble-minded children, one still-born, one that died in five days, two miscarriages, and two normals. If we had this family only, perhaps it would be too hazardous to ascribe these three feeble-

minded children to the influence of the feeble-minded grandmother, but when we look at the other children of this grandmother we find that a second daughter has a feeble-minded child, and a third daughter had an illegitmate child that died young, and later two feeble-minded children born in wedlock, and the third child of that woman was defective in eye-sight. The husbands of these women are not known to have been defective. It seems a clear case of the defect passing over from the grandparents to the grandchildren.

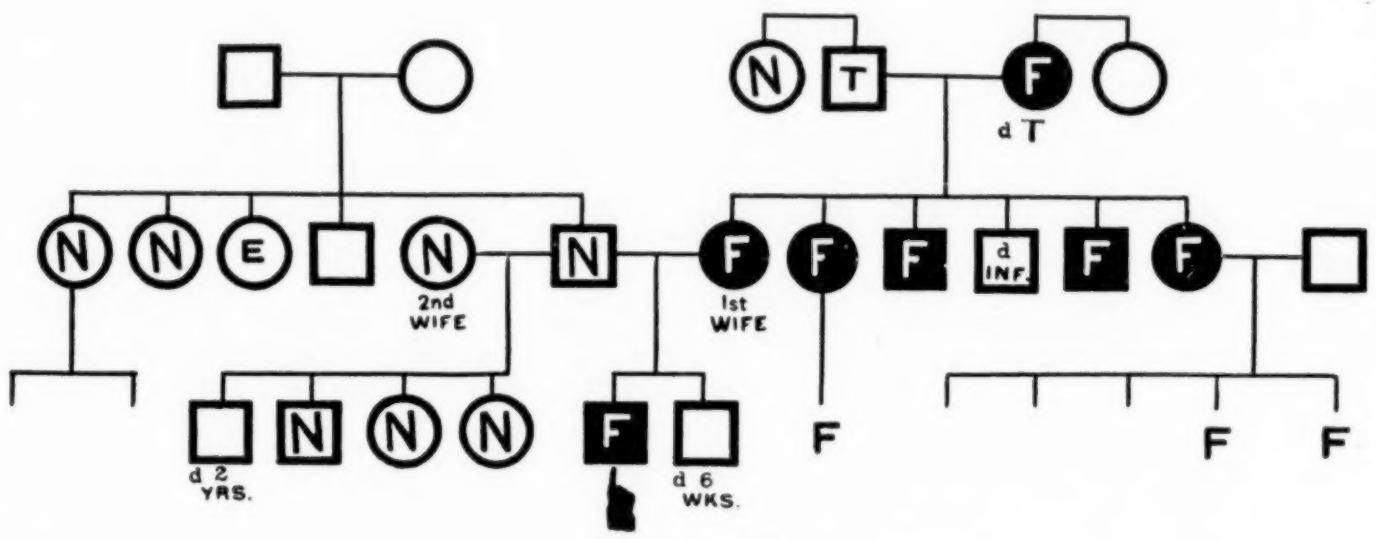


CHART VII.

Chart VII shows the father twice married. His first wife was feeble-minded, and bore him one feeble-minded child and another child that died at six weeks. As will be seen, this wife's family is a bad one, there being five feeble-minded children from a father who was tubercular and a mother who was tubercular and feeble-minded. Two of the sisters married. One had at least two feeble-minded children, the other had one. Coming back to the father of our child, he married the second time a normal woman who gave birth to three normal children and one who died at two years.

Chart VIII (in two parts) is in some ways the most astonishing one we have. There are in the institution at Vineland five children representing, as we had always supposed, three entirely independent families. We discovered, however, that they all belonged to one stock. In Chart VIII, *A*, the central figure, the alcoholic father of three of the children in the institution, married for his third wife a woman who was a prostitute and a keeper of a house of ill-fame, herself feeble-minded and with five feeble-minded brothers and sisters. One of these sisters is the grandmother represented on Chart VIII, *B*.

On *A* it will be seen that this alcoholic man was four times married. He comes from a good family but was spoiled in his bringing up, became alcoholic and immoral—a degenerate man. His first wife,

however, was a normal woman and it is claimed that the two children were normal. For his second wife, he took out of the poorhouse a feeble-minded woman. Her children were: two normal, one that died young, and one feeble-minded. He married the third time. The woman was the prostitute above referred to. She had three illegiti-

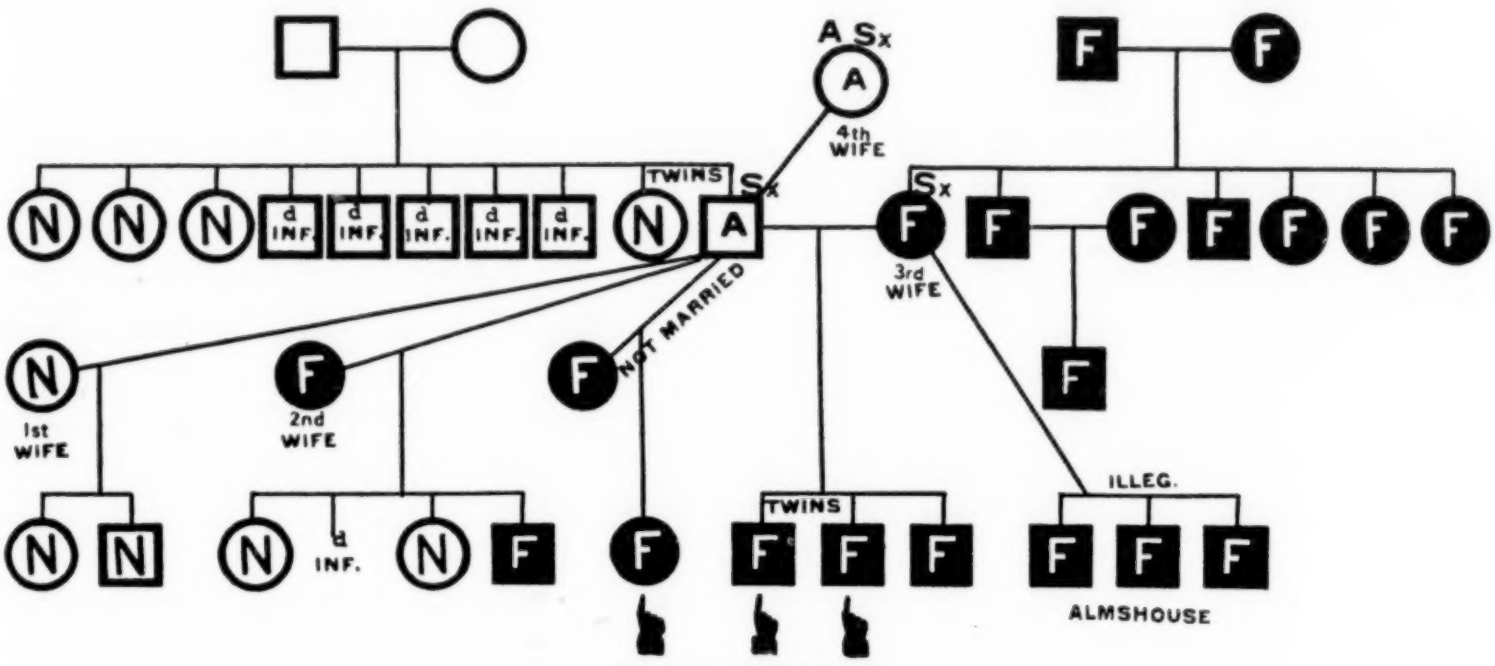


CHART VIII, *A*.

mate children, all feeble-minded. After their marriage, they had three children, all of whom are feeble-minded. Two of these are in this institution. The father then deserted this woman and married a fourth wife who is alcoholic and a prostitute. Of this union, however, there are no children.

There is, moreover, very strong evidence that he is the father of the third child in this institution by another woman, who is also feeble-minded.

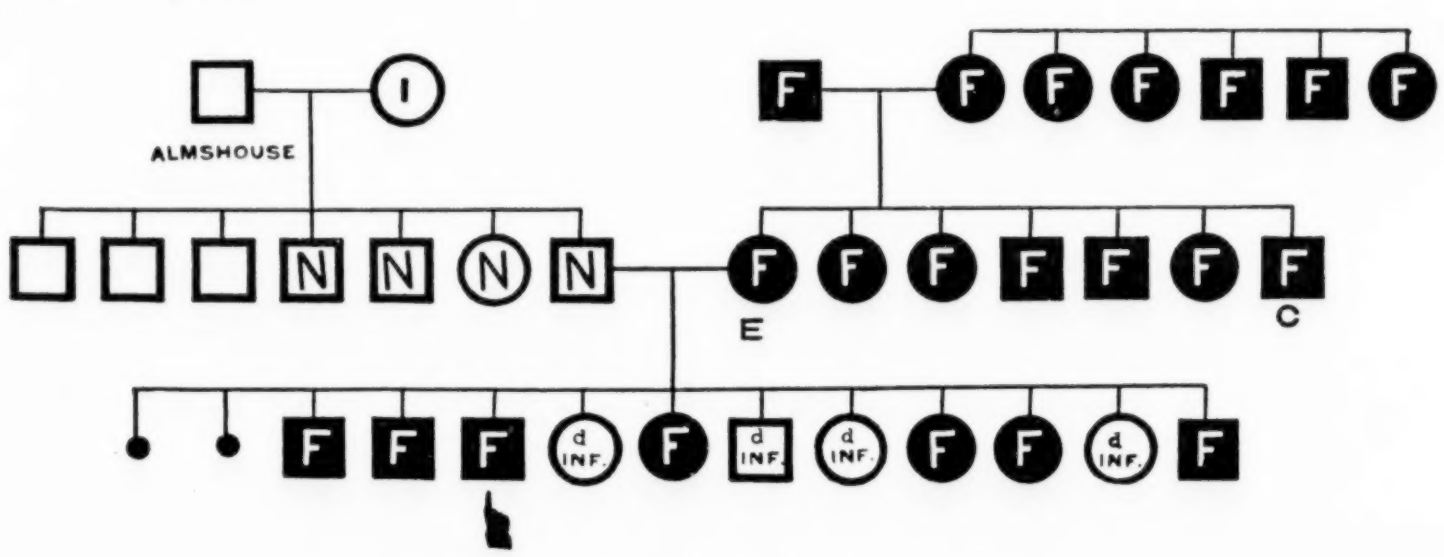


CHART VIII, *B*.

Chart VIII, *B*, will be understood if we note that the mother's mother is a sister of the third wife of the much married man of Chart VIII, *A*. This sister married a feeble-minded man, and the result

of that union was seven feeble-minded children, of whom one is a criminal and one an epileptic. Four are married. The feeble-minded epileptic woman married a normal man, who is one of a fairly good family. His mother was insane, the father died in an almshouse; however we find no mental defect. As the result of this marriage, we have seven feeble-minded children, four others that died in infancy, and there were two miscarriages. This is the fourth child of this strain that is in our institution. The fifth one referred to is a half-sister of the other girl referred to on Chart VIII, *A*.

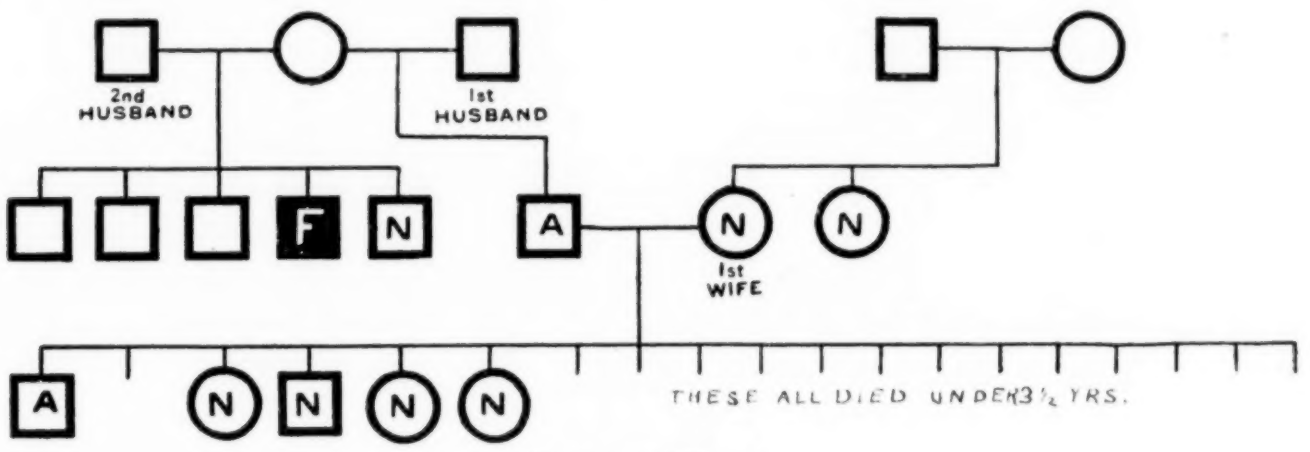


CHART IX, *A*.

Chart IX (also in two parts) is another one of nature's experiments. The father of the child in this institution, an alcoholic man, was married twice. His first wife was a normal woman of good family. The result of this union was nineteen children, all born within a period of nineteen years. Thirteen of these children died under three and a half years of age, three are distinctly normal, one

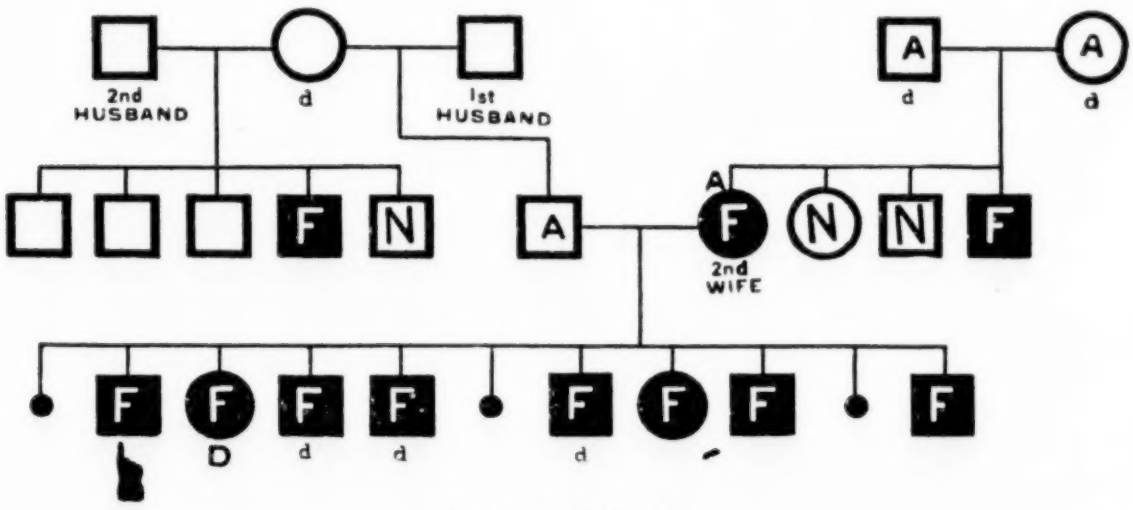


CHART IX, *B*.

neurotic, one alcoholic, and one unknown. This man had a congenital defect in the number of joints in the fingers. However, not one of these nineteen children showed that defect.

This man was married a second time to a feeble-minded and alcoholic woman, the daughter of two alcoholic parents. She has a

feeble-minded brother, besides a normal brother and a normal sister. The result of this union was eleven more conceptions, three resulting in miscarriages and the rest mental defectives. Every one of these children shows the father's defective fingers or toes, one of them is also deaf. Apparently the first wife was prepotent and overcame entirely the husband's defect of fingers, and there was no feeble-mindedness. In the second marriage, however, this defective woman was not prepotent in that she allowed him to transmit his physical defect, although she transmitted her mental condition.

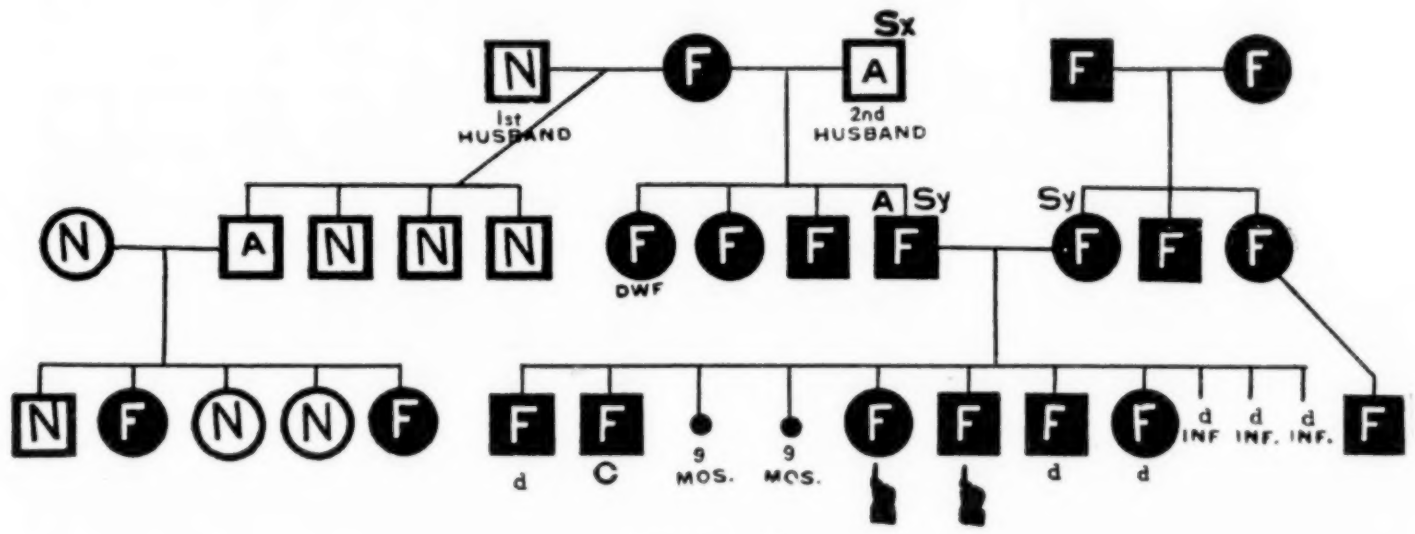


CHART X.

Chart X shows the descendants of a feeble-minded woman who was married twice. Her first husband was normal. There were four normal children, one of whom is alcoholic. This alcoholic son married a normal woman and produced two feeble-minded and three normal children. This is another instance of the defect skipping a generation, being transmitted by the grandmother through the father.

The second marriage of this feeble-minded woman was with an alcoholic and immoral man. The result was four feeble-minded children. One of these became alcoholic and syphilitic and married a feeble-minded woman. She was one of three imbecile children born of two imbecile parents. The result here could, of course, be nothing but defectives. There were two still-born, and three that died in infancy. Six others lived to be determined feeble-minded. One of these was a criminal. Two are in the institution at Vineland. The mother's sister also has a feeble-minded son.

Chart XI also brings together in its two parts *(A* and *B)* two children in the institution that were not previously known to be related. The maternal grandmother in *A* is the maternal grandmother in *B*, being the grandmother of both of these children, as well as of several other defectives. The mother of our child on *A* was

an illegitimate daughter of this woman. She was feeble-minded; she married a feeble-minded son of a feeble-minded man. The result was two children that died in infancy, three miscarriages, and two mental defectives. Going back to the grandmother, we find that she married, later, a normal although neurotic man. The result of that union was one feeble-minded, one normal and neurotic, and three that we do not know about.

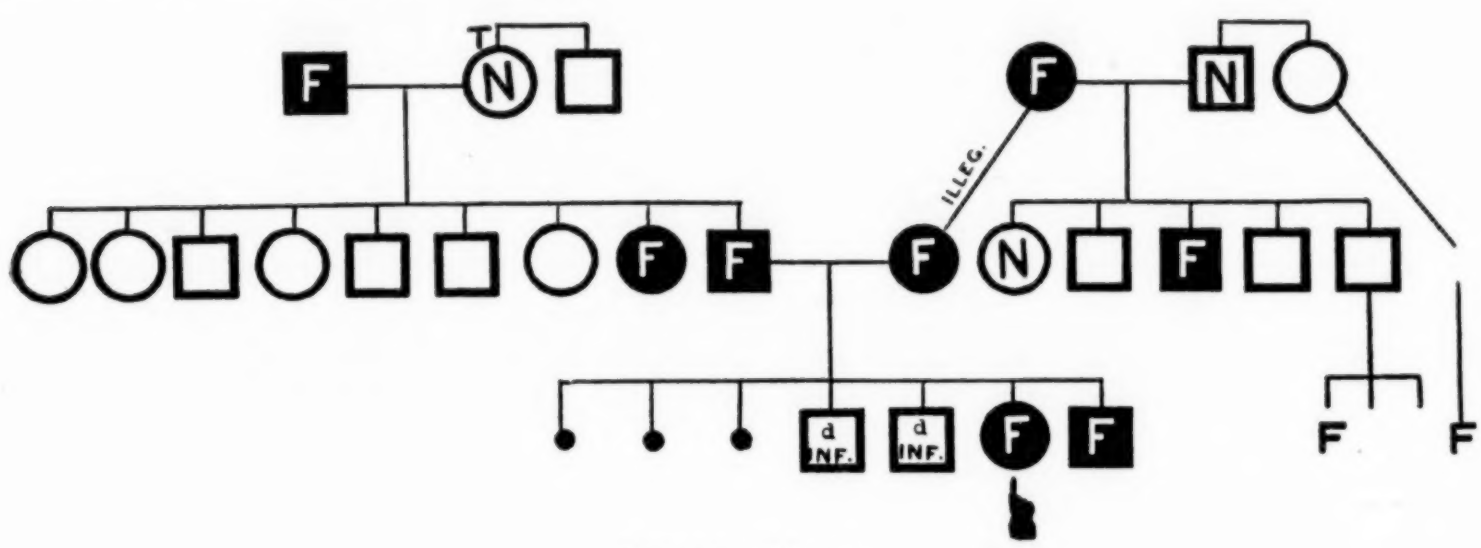


CHART XI, *A*.

Chart XI, *B*, is somewhat complicated, but shows many variations. For example, one of the sons of this same woman had three children, one of whom was feeble-minded. A neurotic daughter married a feeble-minded man who had two feeble-minded brothers and two normal brothers. The result of this union was the child that is in our

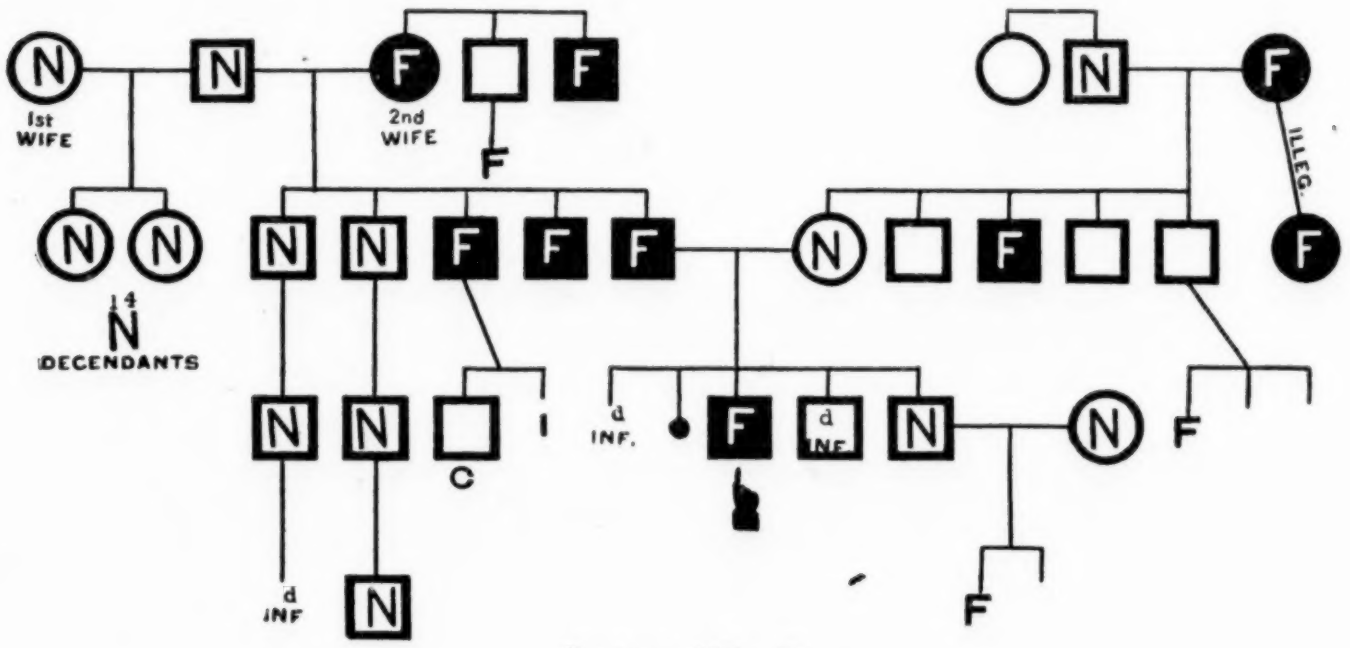


CHART XI, *B*.

institution, two that died young, one miscarriage, and one normal man. This normal man married a normal woman and had two children, one of whom is feeble-minded.

Going back to the father of our child, we find that one of his feeble-minded brothers married a woman who was spoken of as a pervert.

They had two children, one of whom was a criminal and the other insane. Two other brothers were normal. One had a normal son and a normal grandson; the other has a normal son, and a grandchild that died in infancy. Going back to the third generation, we find that the grandfather was twice married. He was normal; his first wife was normal. They had four[a] normal children and fourteen descendants, all normal. He married for his second wife the feeble-minded woman who was the mother of the children already referred to. She had a brother who was feeble-minded, and another brother whose mental condition is unknown, but whose child was feeble-minded.

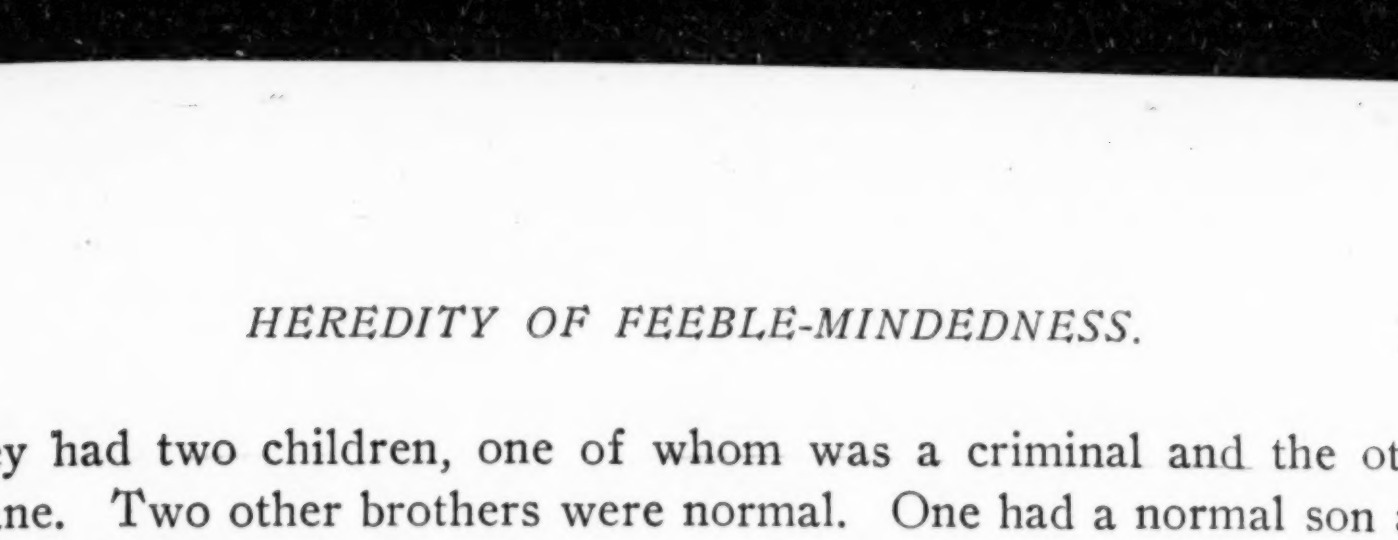


CHART XII.

Chart XII shows a type of imbecility that is clearly not hereditary. It will be seen that all this family on both sides are normal people, with the exception of one woman who is reported as being insane

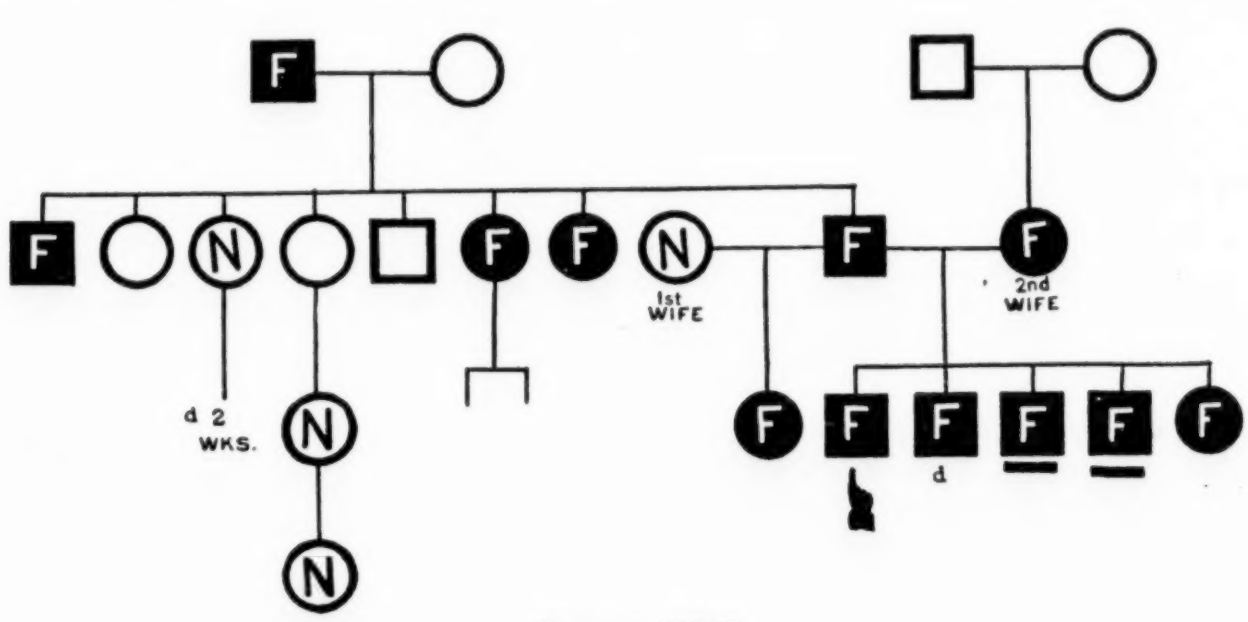


CHART XIII.

with religious mania. The child in our institution is what is known as the Mongolian type, and we have come to believe that there will be no other mental defectives found in such families. Usually such

[a] Only two shown on chart.

a child is the last born. In this case, there was one other child later, but he died at the age of ten months. Mongolism is an arrest of development resulting from some cause acting *in utero*, perhaps about the second month.

Chart XIII presents nothing new, but emphasizes what we have already seen. Two feeble-minded parents have five feeble-minded children. The paternal grandfather, however, seems to have been the one that transmitted the defect on the father's side.

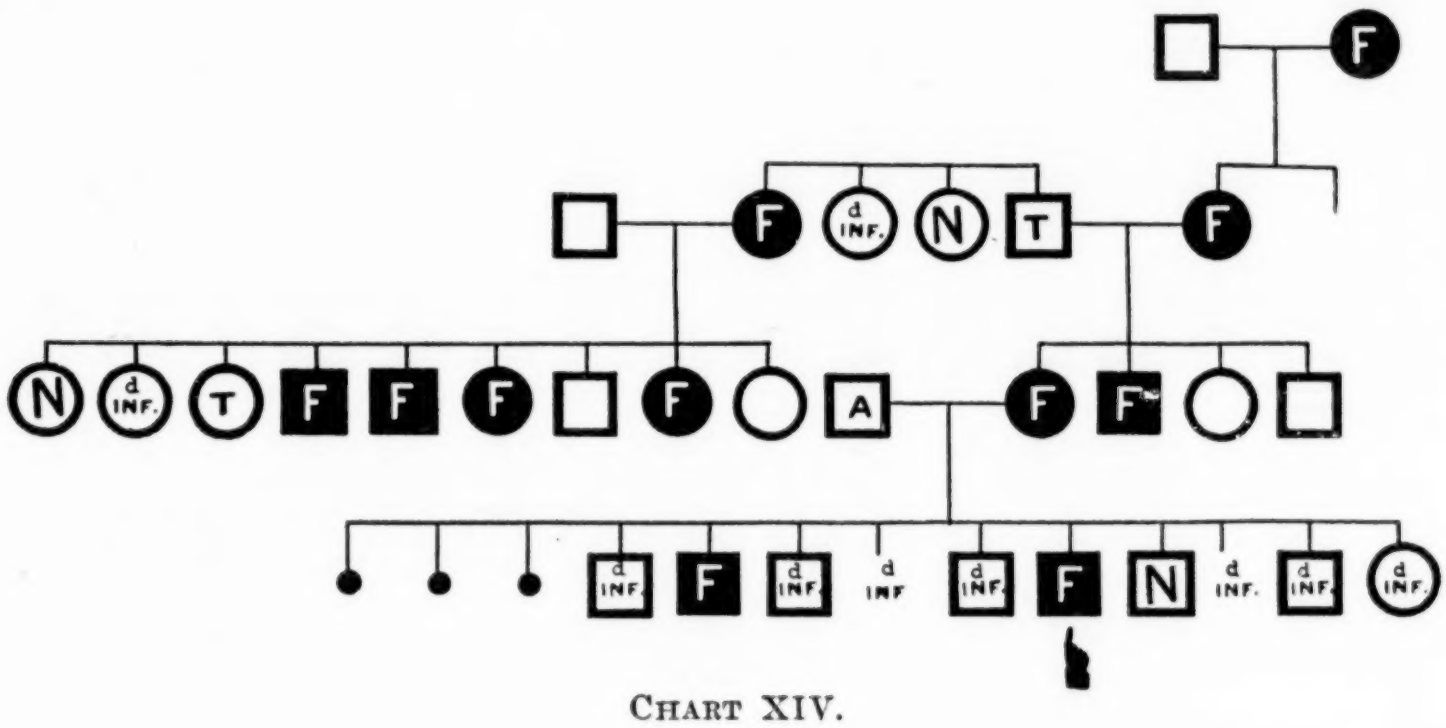


CHART XIV.

Chart XIV is particularly interesting as showing the mental defect running through four generations, and through the mother's family in three of these, although there is defect on the father's side also in the third generation.

Chart XV perhaps adds nothing new for heredity, mainly emphasizing the exhibits of the other charts. However, for a social study, it is perhaps the best of anything that we have yet found. Here we have a feeble-minded woman who has had three husbands (icluding one "who was not her husband"), and the result has been nothing but feeble-minded children. The story may be told as follows:

This woman was a handsome girl, apparently having inherited some refinement from her mother, although her father was a feeble-minded, alcoholic brute. Somewhere about the age of seventeen or eighteen she went out to do house-work in a family in one of the towns of this State. She soon became the mother of an illegitimate child. It was born in an almshouse to which she fled after she had been discharged from the home where she had been at work. After this,

charitably disposed people tried to do what they could for her, giving her a home for herself and her child in return for the work which she could do. However, she soon appeared in the same condition. An effort was then made to discover the father of this second child, and when he was found to be a drunken, feeble-minded epileptic living in the neighborhood, in order to save the legitimacy of the child, her friends saw to it that a marriage ceremony took place. Later another feeble-minded child was born to them. Then the whole family secured a home with an unmarried farmer in the neighborhood. They lived there together until another child was forthcoming which the husband refused to own. When finally the farmer acknowledged this child to be his, the same good friends interfered, went into the courts

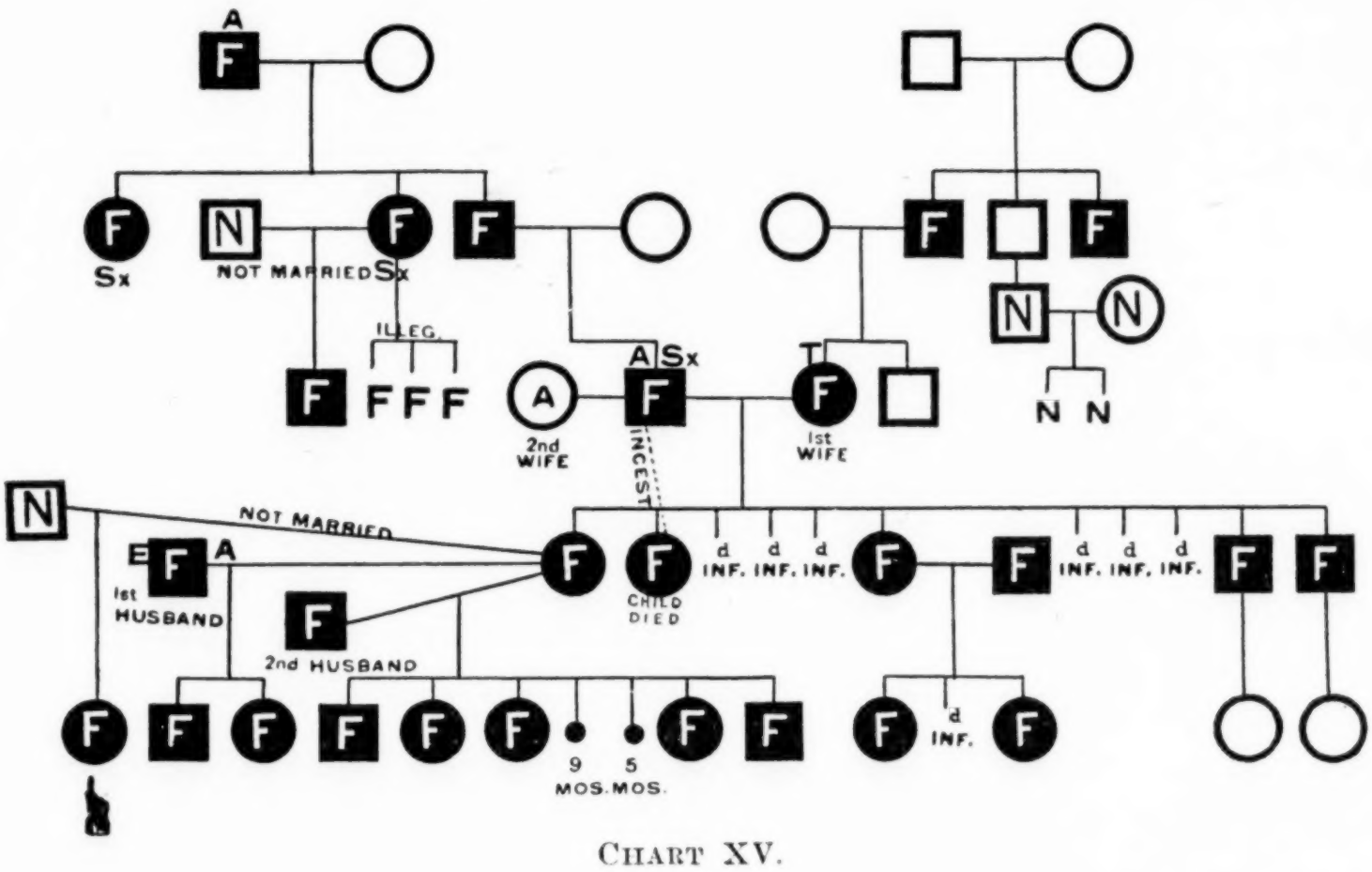


CHART XV.

and procured a divorce from the husband, and had the woman married to the father of the expected fourth child. This proved to be feeble-minded, and they have had four other feeble-minded children, making eight in all, born of this woman. There have also been one child still-born and one miscarriage.

As will be seen from the chart, this woman had four feeble-minded brothers and sisters. These are all married and have children. The older of the two sisters had a child by her own father, when she was thirteen years old. The child died at about six years of age. This woman has since married. The two brothers have each at least one child of whose mental condition nothing is known. The other sister

married a feeble-minded man and had three children. Two of these are feeble-minded and the other died in infancy. There were six other brothers and sisters that died in infancy.

Such is the bare presentation of a few of our cases already worked up. We have made no attempt to study these points, or to mark them statistically, as such labor will be more worth while when all of our cases are completed.

It should be stated that while Chart XV and Chart VIII are undoubtedly the worst cases we have come across, the others here presented are hardly exceptional. They can be matched by many that we already have on file.[b]

We have nearly four hundred children in the institution, and we may reasonably hope to present a fairly complete family history of at least two-thirds of these. If this prediction is verified, it will give us enough data to deduce something of importance concerning human heredity. The work is going on as fast as we can push it. We have now three workers in the field, and will perhaps add a fourth before very long. Later we shall hope to present a full report of all our findings.

HISTORY AND PECULIARITIES OF THE MULE-FOOT HOG.

W. J. SPILLMAN, *U. S. Department of Agriculture.*

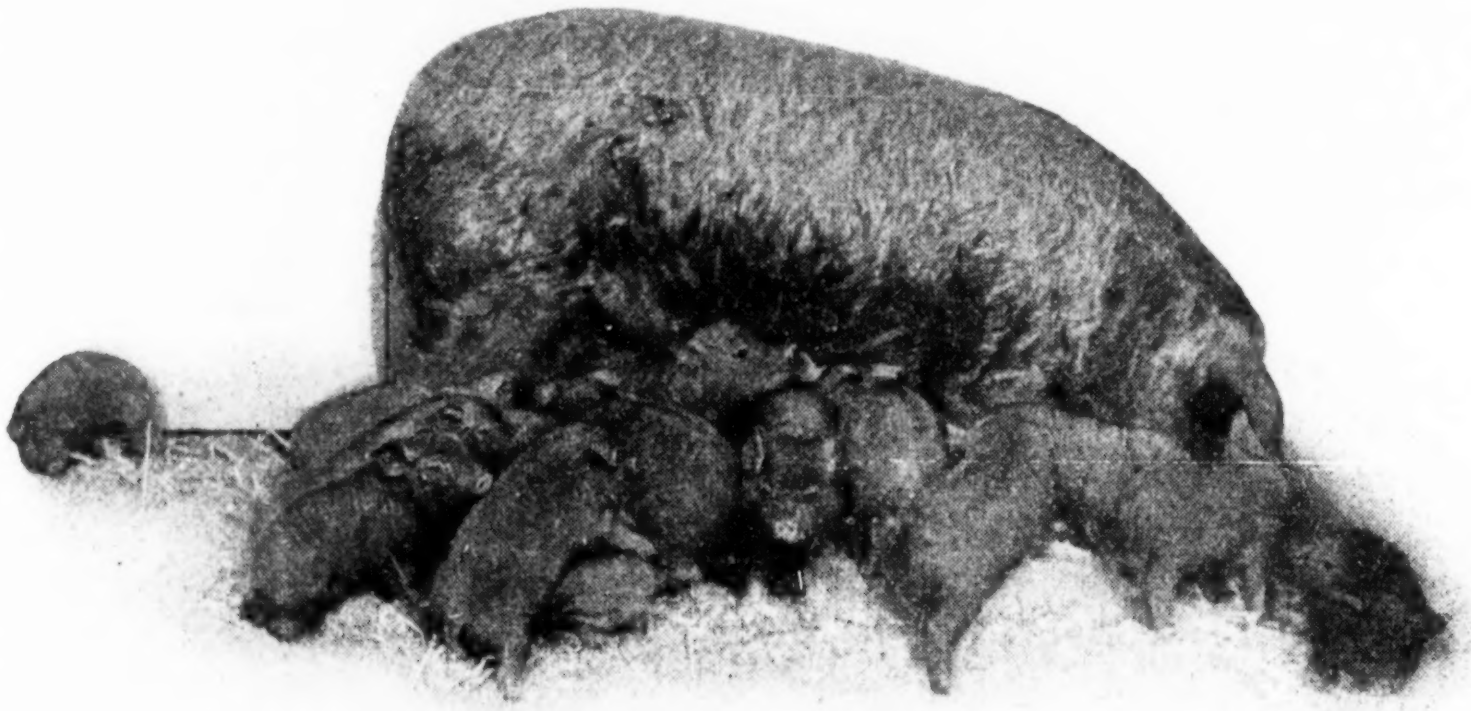
The principal peculiarity of this breed of hogs lies in the fact that the hoof is solid, like that of the horse or the mule, instead of being cloven, as in ordinary swine. In other characteristics they do not differ noticeably from common breeds. In color they run the whole gamut of swine colors, though most breeders are endeavoring to establish solid black as a breed characteristic. The first two illustrations show representative specimens of this breed.

DISTRIBUTION IN THE UNITED STATES.

The idea is prevalent in this country that these hogs originated in Arkansas and the Indian Territory, or what is now the State of Oklahoma; but from what follows it will be seen that this is doubtful,

[b] Since this was written this family has been further investigated with the result that we now know the facts concerning 319 members, of whom 119 are feeble-minded with only 42 known to be normal.

though they have been common in that section for more than half a century. Mr. C. E. Quinn, who was formerly connected with the Department of Agriculture and who was interested in this breed of hogs, secured addresses of breeders of mule-foots as follows: Indiana, 145; Missouri, 16; Illinois, 13; Iowa, 12; Ohio, 9; Minnesota, 8; Arkansas, South Dakota, and Wisconsin, each, 4; Kansas, Kentucky, Nebraska, and South Carolina, 3 each; California and Texas, 2 each; and 1 in each of the States Alabama, Georgia, Louisiana, North Carolina, Oklahoma, Pennsylvania, and Tennessee; a total of 235 breeders in twenty-two States. This shows that the breed is rather widely distributed. Two breeding associations have been formed for the



LITTER OF MULE-FOOTS.
Photo furnished through courtesy of Mr. W. H. Morris, Indianapolis, Ind.

registration of mule-foots, one at Mammoth Springs, Ark., organized in 1904, D. D. Gilson, president; the other organized in 1908 at Indianapolis, Ind., W. H. Morris, secretary.

HISTORY.

In the short time I have had to prepare this paper I have been unable to verify the statements which follow concerning the history of these hogs. One breeder in the State of Oklahoma says: "These hogs some sixty years ago were originally brought from the South Sea Islands and turned loose in the Kimish and Little River Mountains in the Choctaw Nation for the use of the Indians, and have lived there up to the present time." He further states that he has a considerable

trade in these hogs with zoological parks. He does not give his authority for the statement concerning the shipment from the South Sea Islands.

Other breeders, in their catalogues, make the claim that the mule-foots originated from a cross between the peccary and the hog. This claim is evidently based upon the supposition that the peccary has a solid hoof, which, however, is not the case. The peccary does lack one toe on the hind foot, but it is one of the small hanging toes, so that the peccary has a split foot like that of the ordinary hog.

OHIO CHIEF, REPRESENTATIVE OF MULE-FOOT BREED.
Weight 910 pounds. Photo furnished through courtesy of Mr. W. H. Morris, Indianapolis, Ind.

Another breeder states that the mule-foots were brought to Delaware from Sweden in the year 1637. This statement is of some interest in connection with a statement of Mr. Q. I. Simpson, of Palmer, Ill., that an old writer speaks of a solid-hoofed breed in Sweden in the vicinity of Udall. Mr. Simpson is also authority for the statement that one of his neighbors, Mr. Madison Curvey, on a trip to Texas some sixty years ago, saw these hogs in the Choctaw Nation, and states that the tradition of peccary ancestry was then held by the squaw men. Mr. Simpson further states that Darwin, in 1859, mentioned

the appearance of these hogs in Scotland. Mr. Madison Curvey, above referred to, also states that he saw mule-foot hogs at Nauvoo, Ill., in 1844. Mr. Simpson further states that Aristotle, in writings entitled "Researches about Animals," about 370 B. C., tells of solid-hoofed swine in Greece.

BONES AND HOOF FROM THE FOOT OF A MULE-FOOT HOG.

In the specimen at the left the last two phalanges are united; the remaining phalanges are separate, as in ordinary hogs. In the specimen at the right the last pair of phalanges is completely united, and the next pair partially so.

While I have not had an opportunity to verify the evidence here presented, it suggests that solid-hoofed hogs have come down from ancient times, and it is not improbable that this characteristic has been found in certain strains of hogs since these animals were first domesticated.

RELATION TO CHOLERA.

Not the least important fact concerning this breed is that breeders are selling mule-foot hogs with the guarantee that they are immune to cholera. The writer has seen numerous statements from farmers who claim that they have exposed mule-foot hogs to cholera and that none of the hogs took the disease. He has seen one or two statements from farmers contradicting this. Recent tests at some of the experiment stations indicate that the claim of immunity to cholera is not well-founded. Mule-foots exposed to cholera died as promptly as other breeds. The Indiana State Experiment Station has made such a test, and reports as follows in Bulletin No. 140 (1910):

> Four pure-bred mule-foot hogs and four hogs of mixed breeding, averaging about 40 pounds in weight, were used in making the test. The hogs were exposed in the natural way, by turning them into an infected pen in which hogs having acute hog cholera had died. All of the mule-foot hogs contracted the disease, three developing the acute, and one the chronic form. Three became fatally ill and the fourth recovered after several weeks. Three of the hogs of mixed breeding sickened and died or were killed, and the fourth showed no symptoms of disease.

ANATOMICAL STRUCTURE.

About two years ago the writer obtained from Mr. Q. I. Simpson, of Palmer, Ill., the foot of a freshly killed mule-foot hog, from which, after the flesh had been removed by boiling, a photograph was taken. (See page 181, figure at the left.) From this specimen it will be noted that the metacarpals, basilar phalanges, and middle phalanges are separate as in ordinary hogs. The ungual phalanges have coalesced. The figure at the right shows the bones from the foot of another individual. In this specimen two pairs of phalanges are united.

It is interesting to note that in crosses between mule-foot hogs and ordinary breeds the mule-foot character seems to be dominant. Some hogs of mixed breeding have hoofs that are solid at birth but in which the toes split apart usually at about nine months of age. In some individuals the rear toes split apart in this manner, while the front toes remain solid through life. An anatomical study of a series of bones of these mixed breed hogs would probably reveal facts of considerable interest in connection with the inheritance of the mule-foot character.

CLIMATE AND EUGENICS.

CHAS. E. WOODRUFF.

It is rather remarkable that, though it is an accepted biological axiom that a species of living thing survives because it is adjusted to its environment, there is a strong reluctance to apply the same law to varieties of man. There is a widespread notion that man is independent of environment by reason of his intelligence, by means of which he can create artificial protection against adverse factors, climatic or otherwise. This is all the more amazing in view of the overwhelming mass of evidence that types do die out when they wander too far from the locality which evolved them. In this process of decay, the successive generations are more and more degenerate, until extinction ends the line. One of the purposes of eugenics is to investigate these migrants, to determine the causes of the injury, with a view to advocating means of avoiding the adversities and perhaps insuring permanent survival in places where it is now impossible.

The first step to take is to acknowledge that the characters of a type or race have been evolved to adjust it to its environment, either as a passive protection against harmful influences or as an instrument in the active struggle for existence. Color, stature, bulk, and each other character therefore means something vital to survival in the environment which evolved it; but when migration takes place a character may no longer be of use, although if it is not a disadvantage, other than the expense of producing it, it may persist permanently. Head shape may be of this nature. On the other hand, stature and bulk, by ordinary laws of radiation, are of vast importance in preserving body heat in a cold environment, and a fatal disadvantage in hot climates. The bulky are found in the one and the slender in the other, and with equal longevity, but American life insurance statistics show that our overweights are notedly shorter-lived than the underweights. Von Schmedel proved fifteen years ago that pigments were evolved to exclude the dangerous short waves of light and the ultraviolet so fatal to unprotected protoplasm. The investigations of the last five years have established his generalization on a firm basis, and it has been repeatedly shown that light types are evolved in regions where it is so cloudy that there is not much need of protection, but that when they migrate to light countries they melt away. If they

happen upon cloudy places, as in the mountains of central and southern Europe, they apparently survive permanently. Similar survival will follow appropriate residence in America, but in our sunny Northwest numerous observers have reported appalling conditions even in the first generation of native-born descendants.

Here, then, is a condition of affairs which prohibits healthy, normal development, and eugenics must take it into consideration. The importance of the matter needs no comment, as it is evident that these types from northwestern Europe furnish our best citizenship and must be preserved. They are the best that Europe breeds and must be bred up here through the creation of a perfectly hygienic environment. It is of little permanent value to the race to have these types flourish for one or two generations, if the subsequent ones are to melt away from tuberculosis. Even in the more cloudy New England they do have a higher death rate and the population becomes steadily more brunet by the survival of the fittest. Ordinary men only consider present conditions and do not compare with the past as scientists, but eugenics must look forward centuries in a process of breeding in which only three generations extend over a century.

Before final extinction of a type, it necessarily furnishes one or more generations more or less unfit for the struggle for existence, and these become social parasites. An examination of the inmates of hospitals, sanitariums, asylums, prisons, and almshouses in each part of the country is a vital necessity, to show what types are in an undue percentage. My own investigations have been purely as to pigmentation, and they prove conclusively that in this latitude as in the similar ones of southern Europe the lightest types are the least fit, and that propagation of normal offspring is impossible. All other characters, like tallness and weight, must also be investigated and the inmates grouped according to their resemblance to the three main types in Europe—Nordic, Alpine, and Mediterranean—remembering, of course, that the Mediterranean type once extended all over Europe and still survives nearly everywhere, though it developed the Nordic type at or before neolithic times, and that the Alpine intruded itself about the bronze age.

The next great work is an ethnological survey of the whole population, together with a determination of whether there has been any change in families of more than four generations' residence. It must be remembered that by Mendel's law it is possible for more

or less pure types to appear even when the parents differ. Consequently, if all the blondes disappear the family may become brunet and of approximately pure type. We cannot assume amalgamation, but merely an alloy in which one metal distills off.

My investigations so far show that climate evolves type and that migrants survive or perish according as they settle in a climate similar to or different from the ancestral one. When there is a marked difference it is a bar to eugenic development. Moreover, if the adverse factor can be discovered, it may be a simple matter to guard against it and produce healthy, vigorous posterity of the brainy race of northern Europe. Of course, all hope of increasing the size of the brain by selection of proper mates must be abandoned as absurd, and in addition some of the best thinkers are physical defectives, unfit for procreation. Bizarre suggestions to select mates and breed up a physically better type may result in handsome imbeciles. A selection so far found practicable is that based upon property and has been in successful operation a long time in Europe among the upper classes. The only thing we can do is to allow the young to marry whom they please—a thing they will do anyhow—and then prevent the destruction of the offspring by avoidable factors in the environment, and the most deadly of these are climatic. An enormous birth rate has hitherto been necessary to supply material for *human natural selection,* but it is too expensive. We must utilize what the more frail modern woman can produce—a woman who would promptly perish were she to bear children as often as her ancestors. Eugenics then must devise means of rearing a higher percentage of infants, for at present the death rate among them is still appallingly high.

[Presented by the Committee on Eugenics.]

REPORT OF COMMITTEE ON BREEDING NUT AND FOREST TREES.

GEO. B. SUDWORTH, *Chairman.*

This Committee on Breeding Nut and Forest Trees has, within the last few years, fully surveyed in its annual reports the field of tree breeding and pointed out its possibilities and limitations. The work now before the committee is to follow the course outlined, and to report from time to time the progress made and the results obtained.

It is only natural to expect that more rapid progress will be made in the breeding of nut trees than in the breeding of forest trees, as is shown by the papers of individual members of the committee accompanying this report. The results obtained are presented in detail in these papers. In the case of nut trees the improvement sought is in the form and quality of the nut, a fruit produced either annually or at short intervals, and, therefore, more responsive to human influences. The establishment of new varieties of nut trees can be brought about more readily by grafting and budding than by a selection of seed. In the case of forest trees the improvements sought are chiefly in the physical properties of the wood, or in the production of species or varieties resistant to drought, insects, and fungous diseases. If these qualities are to be produced alone by breeding, they can not be secured except by the long, tedious process of seed-selection, which may require several generations of trees. Since, however, the breeding of forest trees is still in its infancy in this as well as in older countries, no results can be expected within a short time. Progress, though, has actually been made along this line by the creation of the necessary means of carrying on such long-time experiments in the form of two forest experiment stations. One is located at Flagstaff, Ariz., and known as the "Coconino Experiment Station." The other is on Pikes Peak, near Manitou, Colo., and is known as the "Fremont Experiment Station."

As a preliminary step toward such experiments at these stations a study was made last season of the differences in the size, weight, and vitality of tree seeds of the same species, obtained from individuals grown under different conditions of climate and elevation. Perhaps the most interesting results along this line were those obtained with older and younger Western Yellow pine (locally the young trees are known as "black jack"). Tests of seed from old trees ranging in age from 280 to 425 years gave an average per cent of germination of 68.4; while seed from young trees, ranging in age from 125 to 145 years, gave 83.2 per cent of germination. These results demonstrate the superior value of young Western Yellow pine for seeding purposes. If to the inferiority of old yellow pine be added the greater danger of being thrown by wind, one can appreciate the importance of these results for forestry, particularly in timber forest planting.

In the table of germination tests (page 188) there have been brought together the results of seed tests of nine different species of

native conifers obtained from thirty-eight widely separated localities in the western half of the United States.

Samples of seed of *Pinus ponderosa* have been received from eighteen Forests; these Forests are so scattered that the samples may be taken as fairly representative of the variations met with in the seed of this species. While only one sample, that from the Datil Forest, was stated to be of the variety *scopulorum,* it is quite probable that several others were in reality this variety, and one or two are perhaps mixtures of the pure species with the variety.

In two characteristics the samples of *Pinus ponderosa* vary to a remarkable extent, namely, in size or weight of seed (number of seeds per pound) and in rapidity of germination (shown by the germination per cent at different times). Furthermore, these two characteristics are apparently correlated, for the light seed usually germinates much more rapidly than the heavy seed. Again, there is a distinct connection between these characteristics and the region from which the seed comes. The light quick-germinating seed comes from the eastern slope of the Rockies and from the south, while the heavy, slow-germinating seed comes from farther north and west. This connection between the characteristics of the seed and the region from which it comes has been noticed by European purchasers of American seed (Rafn); it was also pointed out in the 1907 Forest Service circular on "Germination of Pine Seed."

By means of these characteristics of the yellow pine seed, it is possible to divide the National Forests into three definite regions. The first includes the eastern part of District 1, all of Districts 2 and 3, and the southeastern part of District 4. Here the seed is usually small (it varies greatly in size, however, especially in Arizona) and germinates very rapidly. The second region includes the western part of District 1 and the northern part of District 4. Here the seed is large and usually slow (but somewhat variable) in germination. The third region is the Pacific Coast, District 6, and probably the northern part of District 5 (no samples of *P. ponderosa* have been received from California during the past winter). Here the seed is very large and very slow and irregular in germination.

The sample from the Helena Forest appears to be intermediate in character between the samples of the first region mentioned above and those of the second. The seed is considerably larger than any of the samples from the former, yet it germinated (in soil) more rapidly than any other of the eighteen samples.

Germination tests of nine different species from thirty-eight widely separated localities.

Species.	National Forest.	Germination per cent.								Number of seeds per pound of sample that may germinate.
		Two weeks.		Four weeks.		Six weeks.		Present time.		
		Chamber.	Soil.	Chamber.	Soil.	Chamber.	Soil.	Chamber.	Soil.	
Larix occidentalis	Blackfeet	17.5	15.5	37.0	29.5	42.5	34.5	45.0	40.5	53 340
Do*	Flathead	12.5	9.0	29.5	11.5	34.0	19.0	37.0	27.0	33 800
Do*	Helena	18.5	4.5	33.0	5.5	39.0	12.5	39.5	17.0	22 720
Do*	Lolo	9.0	7.5	23.5	13.5	27.0	15.5	27.0	26.0	16 760
Pinus murrayana	Deerlodge	26.0	72.5	37.5	77.5	42.0	78.0	48.0	78.0	95,350
Do	Helena	7.0	13.5	13.0	16.0	16.5	18.0	16.5	18.0	24 350
Do	Shoshone	47.5	27.5	65.0	61.5	69.5	61.5	70.5	61.5	54 300**
Do*	Leadville	16.0	60.0	42.0	65.0	57.0	67.5	57.0	68.0	78 100
Do	Medicine Bow	13.5	49.5	21.0	64.0	28.0	68.5	46.0	68.5	65 750
Do	Bonneville	30.0	50.0	51.5	73.0	55.5	74.5	61.0	74.5	62 500
Do	Targhee	39.5	76.5	60.0	86.0	65.5	86.5	65.5	86.5	88 000
Pinus ponderosa*	Cabinet	20.5	40.5	38.0	61.0	53.0	67.0	68.5	78.5	6 780
Do*	Coeur d'Alene	11.0	24.0	41.5	50.0	57.5	67.5	73.5	81.5	7,700
Do*	Helena	48.0	70.0	57.5	71.5	62.5	71.5	63.5	71.5	7,320
Do	Sioux	78.0	80.5	86.0	84.5	87.0	86.0	87.0	86.0	13 660
Do	Black Hills	35.5	59.0	43.5	61.0	44.5	61.5	44.5	62.0	11 800
Do	Medicine Bow	24.0	30.0	39.0	40.0	42.5	42.0	42.5	42.5	7,700
Do	Pike	65.0	69.5	73.0	76.0	75.0	77.0	75.0	77.0	14,050
Do*	Boise	0.0	2.5	15.5	26.0	33.0	44.5	61.0	76.5	6 060
Do	Payette	10.5	12.0	28.0	27.0	47.0	41.0	60.0	56.0	5 020
Do	Pocatello	7.5	8.5	40.5	45.0	61.5	63.5	70.0	74.5	6,870
Do*	Weiser	3.5	5.5	18.5	16.0	22.5	25.5	33.5	39.5	3,600
Do*	Columbia	1.5	1.5	4.5	8.5	17.5	23.5	44.0	58.5	4,830
Do*	Colville	3.0	19.0	16.0	32.5	35.5	49.5	49.0	74.5	5,480
Do*	Umatilla	9.5	13.5	28.5	34.0	54.5	54.5	71.0	81.0	6,240
Do*	Wenatchee	5.5	13.0	28.5	38.0	42.5	56.0	53.0	73.0	5,270
Pseudotsuga taxifolia	Absaroka	44.0	34.0	53.0	39.0	58.0	43.0	59.5	43.5	16,440
Do	Helena	30.0	24.5	46.5	30.5	49.0	41.0	49.5	43.0	20,770
Do	Medicine Bow	18.0	10.0	23.5	12.5	25.5	12.5	26.0	12.5	7,150
Do	Boise	5.5	3.5	14.5	18.0	18.0	20.5	22.5	20.5	7,420
Do	Pocatello	47.0	11.0	64.0	50.5	72.0	61.0	76.0	62.5	17,450
Do	Targhee	10.0	6.5	20.0	17.5	21.0	20.5	21.0	22.0	6,720
Pinus edulis	Crook	....	2.5	....	4.0	....	4.0	....	4 0	62
Pinus coulteri*	Angeles	....	0.0	....	6.0	....	21.5	....	44.5	490
Do*	Morse Seed Co	....	0.0	....	9.5	....	32.0	....	67.5	940
Pinus lambertiana*	Plumas	....	0.0	....	0.0	....	3.0	....	22.0	570
Picea sitchensis	Olympic	6.5	5.5	21.5	48.5	26.0	51.5	26.5	51.5	96,000
Cupressus arizonica	Chiricahua	12.5	6.5	12.5	7.0	12.5	7.0	12.5	7.0	9,760
Picea sitchensis	Snoqualmie	0.5	8.5	1.5	16.5	1.5	19.5	1.5	21.0	39,700

** This figure is calculated on the basis of the chamber test; the soil test was damaged by insects.

Samples of seed of *Pseudotsuga taxifolia* have been received from thirteen Forests, located chiefly in Districts 2 and 4. The quality of the seed varies so much, however—many of the samples containing large percentages of empty seeds—that the number of seeds per pound gives little clue to the weight of the filled seeds. Furthermore, the germination per cent is mostly so low that the rapidity of germination can hardly be stated. It appears, however, that seed from Idaho takes considerably longer to germinate than seed from Colorado. It may eventually be possible to separate a quantity of filled seeds from each sample and thus obtain more useful figures.

Of the twelve samples of *Picea engelmanni* (shown in the first report), eight came from Colorado, and it is quite probable that the one sample from Montana is mixed with seed of *P. canadensis.* Thus no definite statement can be made regarding this species.

The nine samples of *Pinus murrayana* show considerable variation in size, but very little in rapidity of germination. While the samples from the Targhee and Shoshone Forests are much larger than any other, it is hardly possible to outline definite regions from this characteristic.

Some other characteristics of the seed, which are not brought out in the tables, are worth mentioning. The seed of some species appears to have two periods of germination: the majority of the viable seeds will germinate, and then, after a pause, a further number will do so. This is most noticeable in *Larix occidentalis,* all four samples of which have behaved in this way. The samples of *Pinus ponderosa* from Washington and Oregon, and one or two from Idaho, show signs of the same habit. This behavior is sometimes seen very clearly in seed which has been stored for a long time; stored samples of *Pinus ponderosa* and *P. attenuata,* tested during the past winter, have shown it in a marked degree.

The behavior of *Pinus monticola* is as yet uncertain. It is quite evident that the seed is very slow to germinate, so slow that no report on the germination of the samples can yet be made. The seed from the Coeur d'Alene Forest, sent for storage experiments, has germinated 40 per cent in twenty-two weeks. Various methods of germination are being tried, with good promise of success.

The importance of these results for planting are obvious.

The next step at these stations will be to start next spring plantations with seed obtained from different sources as to region, elevation,

the chamber test; the soil test was damaged by insects.

age, and soundness of mother trees, and to record for the next several years the growth in height, the root development, the weight, the date when new foliage appears and the old is shed, etc. The species to be experimented with at the Coconino station will be chiefly the Western Yellow pine (*Pinus ponderosa*). Seed of this pine has already been gathered from one hundred different individual trees. Each tree receives a separate number and a description including the following points:

Tree number; height (feet); diameter breast high (inches); age (years); yield in cones (bushels); condition of cones; condition of tree; clear length; condition of crown; whether fire-scarred; whether spike-top; other peculiarities; site—slope, ground cover, stand.

At the Fremont Experiment Station the species to be tried are the Engelmann spruce, Douglas fir, Western White pine, and Western Yellow pine.

These experiments will enable us to choose intelligently just the right kind of seed for a given locality and thus save the inevitable disappointment and loss of time and money which come from the use of seeds not adapted to given soil and climatic conditions. Definite results can not be expected in less than five years.

The practical importance of such experiments will become apparent when one realizes that during the last year the national government alone has gathered about 14,000 pounds of tree seed, while the amount of seed to be used in the next five to ten years will be many times this amount. Upon the choice of this seed will depend the character and quality of the future forest that will come from it.

The improvement, however, of our forest resources does not need to be delayed altogether until we can secure, by gradual selection, species and varieties that will meet our economic needs better than the species on hand. There are other means of improving the quality of our forests besides breeding. The introduction of exotics and silvicultural treatment of the forests are two methods which may bring about identical results, and in a much shorter time than would be possible by breeding alone. The introduction of new blood and the improvement of the stock on hand are requisites for the accumulation of qualities for transmission by breeding. The introduction of exotics and silvicultural treatment must, therefore, be considered as essential parts of the general plan of breeding new varieties of forest trees, and progress has been made along these lines.

INTRODUCTION OF EXOTICS.

During the last year an actual trial was made with the following 53 exotic species, of which 39 are eucalypts:

Pinus sylvestris,
Pinus austriaca,
Pinus gerardiana,
Morus alba tartarica,
Pinus chinensis,
Casuarina equisetifolia,
Picea excelsa,
Pistachia chinensis,
Pinus canariensis,
Cedrus libani,
Cedrus deodara,

Eucalyptus amygdalina,
Eucalyptus diversicolor,
Eucalyptus globulus,
Eucalyptus goniocalyx,
Eucalyptus longifolia,
Eucalyptus leucoxylon,
Eucalyptus marginata,
Eucalyptus melliodora,
Eucalyptus mulleriana,
Eucalyptus obliqua,
Eucalyptus pilularis,
Eucalyptus polyanthema,
Eucalyptus punctata,
Eucalyptus regnans,
Eucalyptus rostrata,
Eucalyptus siberiana,
Eucalyptus saligna,
Eucalyptus almenoides,
Eucalyptus bicolor,
Eucalyptus boristoana,
Eucalyptus botryoides,
Eucalyptus cornuta,
Eucalyptus corynocalyx,
Eucalyptus crebra,
Eucalyptus deanei,
Eucalyptus gunnii,
Eucalyptus hemphloia,
Eucalyptus hemphloia albens,
Eucalyptus masculata,
Eucalyptus trabutii,
Eucalyptus microtheca,
Eucalyptus paniculata,
Eucalyptus pulverulenta,
Eucalyptus resinifera,
Eucalyptus rudis,
Eucalyptus siderophloia,
Eucalyptus sideroxylon,
Eucalyptus tereticornis,
Eucalyptus viminalis,
Acacia melanoxylon,
Syncarpia laurifolia,
Quercus suber.

This list does not, of course, include all of the exotic species which can be tried. The following additional species are selected for trial in the near future:

Pinus laricio,
Pinus pallasiana,
Pinus pinaster,
Pinus pinea,
Pinus halepensis,
Pinus bungeana,
Pinus cembra,
Pinus excelsa,
Picea morinda,
Picea orientalis,
Picea alcoquiana,
Abies pectinata,
Abies cephalonica,
Abies nordmanniana,
Abies pindrow,
Larix leptolepis,
Larix curilensis,
Larix siberica,
Cupressus sempervirens,
Chamaecyparis obtusa.

If these prove adaptive to given local conditions, they may in themselves form a valuable addition to our forest resources, or by hybridizing with native species furnish material for further selections and breeding. Of these introductions the most interesting will be the sowing next spring of over 3,000 pounds of Austrian pine. This species may enable us to extend in the Southwest the lower timber line further down into the foothills, where our native yellow pine stops at an elevation of about 5,000 feet, giving way below this level to a scrubby growth of oaks and other chaparral species.

IMPROVEMENTS BY SILVICULTURAL TREATMENT.

The quality of the wood and the growth of forest trees in a stand depend, as every observer knows, upon the way the stand has grown, that is, whether in an overcrowded, dense, or open stand; whether the leaf litter was regularly burned or otherwise removed, or allowed to remain and form a humus; whether the existing stand began under dense shade and remained suppressed for a long time, or started in dense shade of older trees, comprising trees of all ages and sizes, or whether it started in an opening and made a uniform, even-aged stand. It is empirically established that, in the case of broad-leafed species, rapid growth, all other conditions being equal, means, as a rule, a straighter grain and stronger and more serviceable wood; while slow growth means brittle, twisted, and less useful wood. The biological reason for this difference in the quality of wood of the same species grown at different rates, lies in the fact that every decrease or increase in the width of the annual ring means a decrease or an increase of the summer or winter wood, while the kind of wood formed early in the season and known as "spring wood" remains, as a rule, approximately the same in both rapid-growing and slow-growing trees. The summer or winter portion of the annual ring contains few fibro-vascular bundles, is less porous, has thick-walled wood-elements, the presence of which, in larger or smaller quantities, always determines the relative strength of the wood as a whole. Therefore, for broad-leafed trees, the wider the rings, or the more rapid the growth, the stronger the wood, while the narrower the rings, or the slower the growth, the weaker the wood.

In the wood of coniferous trees the reverse is true, owing probably to the simpler structure of their wood, less marked periodicity in the appearance of the foliage, and less transpiration.

It is entirely within the power of the forester to stimulate the growth of trees in the stand by proper and timely thinnings, to produce clear or knotty timber, and thus by silvicultural treatment to control the quality of the timber grown. To what extent improvement of the wood thus brought about may be transmitted by heredity through breeding is still an open question. If, however, as we already know, the size of the seed has an undisputed influence upon the stock produced from it, and the size of the seed varies with the position of the tree in the stand, whether it is dominant or suppressed

—a condition which may be produced artificially in any forest—it may be expected that seed obtained from cylindrical straight-boled trees will stand a better chance of producing wood of more desirable qualities than seed from suppressed knotty, crooked trees. The proof of this, however, can and will be obtained only through the experiments to be started on the relation of the source of the seed and the resulting trees.

SUMMARY.

To sum up, there are three important problems before us:

(1) Selection of tree seeds which are to produce our future forest.

(2) Improvement of the present forest by silvicultural treatment, thus creating better trees capable of transmitting the qualities brought about by such treatment.

(3) Introduction of exotics into regions which either do not support tree growth at all, or, have trees of inferior quality, thus adding directly to the forest wealth of this country and furnishing new material for hybridization and further selections.

Of these three problems the one which promises definite results within a short time is the selection of tree seeds.

This committee considers it most essential at present to lay down principles and methods of tree seed selection for the guidance of foresters and other tree seed collectors in whose hands rests the future of our timber forests.

REPORT OF COMMITTEE ON ANIMAL HYBRIDS.

This committee recently addressed a letter to each of the experiment stations asking for a statement concerning the animal hlbridization work at those institutions. The following experiment stations report more or less work of this character, either now in progress or recently so: Indiana, New Hampshire, South Dakota, Arizona, Florida, South Carolina, North Dakota, Georgia, Michigan, Illinois, New York, Oklahoma, Iowa, North Carolina, Wyoming, and California.

At some of these stations Mendelian phenomena in the crosses between the breeds are being studied, and in most of them the aim of the work is the establishment of new types or breeds. The follow-

ing table gives the lines of work being carried on at each of th stations:

Cross-breeding work with animals at the experiment stations.

Nature of cross.	Station doing work.	Reported by—
Yorkshire swine with representative breeds of the lard type	Indiana	J. H. Skinner.
Breeds of sheep to determine extent of operation of Mendelian law; also to produce sheep particularly adapted for raising hot-house lambs. Reciprocal crosses made with Dorset Horn and Southdown. Hampshire, Southdown, Shropshire, and Dorset rams crossed on Rambouillet ewes and New Hampshire native ewes	New Hampshire	T. R. Arkell.
Algerian sheep with native breeds, to combine adaptability of Algerian to hot dry climates and resistance to pests and diseases, with better mutton and wool-producing characters of other breeds	Arizona	R. H. Forbes.
Poland China hogs with large English Yorkshires	South Dakota	Jas. W. Wilson.
Beef cattle: Native cows with Shorthorn, Hereford, and native males	Florida	P. H. Rolfs.
Kentucky Standard-bred horse with German Coach horse	South Carolina	J. N. Harper.
Hogs, sheep, and poultry	North Dakota	J. H. Shepperd.
Berkshire × Duroc-Jerseys	Georgia	P. N. Flint.
Swine	Michigan	R. S. Shaw.
Some work in progress; nature not indicated	Illinois	E. Davenport.
Barred Rocks and White Leghorns	New York	C. A. Rogers.
Oklahoma station contemplates some cross-breeding work with sheep, but work not yet started	Oklahoma	Jno. A. Craig.
Crosses between different breeds of cattle	Iowa	W. J. Kennedy.
Grading up razor-backs by means of pure-bred Berkshires	North Carolina	C. B. Williams.
Crosses between breeds of sheep	Wyoming	J. D. Towar.
Crosses between Persian and Merino sheep. (Done some years ago)	California	E. J. Wickson.

The Rhode Island Experiment Station has a hybrid between a pheasant and a chicken, which was produced in some experiments conducted by Dr. L. J. Cole, formerly of that station. Dr. H. J. Wheeler, the director of the Rhode Island station, says concerning

this bird: "Its male parent is an ordinary Ring-necked pheasant and the female parent a yellow mongrel Bantam. In plumage the hybrid promises to be more or less intermediate. In build it is rather large and more rangy than the pheasant, and its head, bill, and feet are much like those of the pheasant. In disposition it is extremely wild." Dr. Wheeler states that the Rhode Island Experiment Station will later publish a full description of this hybrid.

CATTALOES.

This committee is keeping in touch, as closely as may be, with the work of three men who are breeding hybrids between cattle and buffaloes, namely, Mr. Mossom Boyd, Mr. Chas. Goodnight, and Mr. C. J. Jones.

Mr. Boyd is continuing the important work upon which he reported to the Association two years ago, and we expect to have other important reports from him in the future. Mr. Goodnight, in answer to a request from the committee to prepare a paper for this meeting, wrote:

> To go into all the details and facts leading up to what success I have made would make too lengthy an article; but as regards the practicability of getting a race or strain of these hybrids, I believe in the end it can be done and that such a race will be of much benefit, supplanting, in a measure, cattle. A grave drawback at the present time is the scarcity of the hybrids. I have bred mostly to Polled Angus. The cross can, however, be made with any cattle. I have made a list of twenty-three points in which I think the hybrids are superior to cattle. Some of the more important of these are:
>
> (1) They eat less.
>
> (2) They digest better.
>
> (3) They put on more flesh with the same amount of food.
>
> (4) They cut more good meat; as far as I can ascertain about 66 per cent of the best cuts.
>
> (5) They are subject to fewer diseases. They seem to be entirely immune to blackleg until they are reduced to about one-eighth buffalo blood, the buffalo itself being absolutely immune.
>
> The extra rib of the buffalo is present in the half-breed, and in some cases in the quarter-breed. The cross-breds are more docile than the buffalo. I have animals varying from half-breed buffalo to one-sixteenth buffalo.

BRAHMIN CATTLE.

Prof. C. L. Willoughby, of the Georgia Experiment Station, is making records of crosses between grade Brahmin cattle and other cattle in Georgia. We hope to be able to present a paper from him on this subject at this meeting, but certainly at the next meeting of the Association.

WOLF-DOG HYBRIDS.

Mr. O. B. Shumway, of Chillicothe, Ill., reports his extensive experience with hybrids between the wolf and the dog. He has captured young wolves and raised them in captivity.

Generally speaking, those wolf characters which differ from those of the dog are dominant in the cross. Some of the hybrids have been raised for the purpose of selling their scalps as wolf scalps.

OTHER WORK.

Prof. F. B. Mumford, dean and director at the Missouri Station, has undertaken to collect a bibliography of animal hybrids.

Mr. Q. I. Simpson, of Palmer, Ill., is continuing his valuable experiments with swine hybrids.

Mr. P. E. Fogle, of North Carolina, has for several years been making careful records of the results of crosses between Herefords and Shorthorns. A brief paper by him will follow this report.

The committee would call attention to the important work of Prof. W. E. Castle in animal hybrids, and especially to the recent publication of the Carnegie Institution giving the results of his work on rabbits.

Some of the most important lines of work in animal hybrids, from an economic point of view, at present in progress in this country are the work with cattaloes, with Brahmin cattle, and with some of the sheep crosses which are being made at several of the experiment stations with a view to producing new breeds better adapted to local conditions.

The committee is in touch with most of the zoological parks in the country, and we have ascertained that at several of them arrangements can be made for the use of some of the animals they possess in crossing with farm animals.

W. J. SPILLMAN, *Chairman,*
Q. I. SIMPSON,
W. J. KENNEDY,
W. E. CASTLE,
F. B. MUMFORD,
P. E. FOGLE,
C. L. WILLOUGHBY,
Committee.

REPORT OF COMMITTEE ON BREEDING FIBER CROPS.

J. H. SHEPPERD, *Chairman.*

Your committee consisting of Dr. Lyster H. Dewey, Professors Alvin Keyser, H. L. Bolley, and myself have not found it possible to have a committee meeting, although the chairman has met Professors Keyser and Bolley for a conference over this matter of breeding fiber crops. Dr. Dewey has furnished a brief paper for the committee, which gives a general review of the situation with the three commercial fiber-producing plants which concern this committee. This statement is as follows:

"The two fiber crops most promising for this country are hemp and flax. Prof. C. P. Bull, of the agricultural experiment station at Saint Anthony Park, Minn., is working in the selection of hemp seed in cooperation with the U. S. Department of Agriculture. Hemp can doubtless be cultivated successfully for fiber as far north as the southern part of Minnesota, and in favorable seasons good crops may be obtained in the Red River Valley; but I would regard it as too uncertain a crop for that region when it requires at least 3½ months for its development. I think that better results in the production of seed may be obtained in regions farther south, even south of Kentucky. Some seed of the fifth generations of selection at St. Anthony Park was tried last year at the experiment station at Lexington, Ky. The plants produced were shorter, and with shorter internodes, than plants grown under similar conditions from Kentucky seed which had not been subjected to any selection. I think this inferiority was due in part to the change of location. Professor Garman, of the Kentucky Experiment Station, tells me that in nearly all instances where he has obtained seeds of other crops from regions where the climatic conditions were different from those in Kentucky the crop of the first year from this introduced seed was inferior.

"There is not only a need for improvement in the quality of hemp, but also a very important need for an increase in the quantity of seed available. Last year the prices of hemp seed ranged from $5 to $7 per bushel, but there was a break in the prices at about sowing time owing to the fact that many of the hemp farmers in Kentucky, discouraged by the high price of seed, turned their attention to tobacco. The latter crop has given them handsome returns this year because the prices have been higher than heretofore. Hemp

seed is now selling at $4 to $5 per bushel, and some of the dealers and farmers think that the prices may rise as high as, or possibly higher than, last year. It would be impossible to secure seed to plant as large an acreage of hemp as the average of the past ten years.

"During the past year the Department of Agriculture began some work in the selection of flaxseed for fiber production in eastern Michigan. Plants were selected in the fields of flax, which is there grown primarily for fiber production. These plants were subjected to careful laboratory tests in accordance with the principles of plant breeding which have been developed at the Minnesota and North Dakota experiment stations, and the seed from the best plants will be used in setting out 100 plant-breeding plats next spring.

"There is a demand for two rather distinct fiber types of flax, one to have coarse strong fiber, suitable for the manufacture of binder twine and other coarse twines, and the other to have a fine flexible fiber, suitable for the manufacture of fine twines, shoe threads, and carpet yarns. There is no demand in this country as yet for a flax fiber for the manufacture of fine woven linens such as are imported. If the flax industry is to be developed in this country, it seems more promising to begin with the coarser and less expensive lines, which may be produced with less skilled labor, and develop gradually toward the finer linens.

"While abacá, the plant cultivated in the Philippines for the production of fiber commonly known in our markets as "Manila hemp," can not be grown in this country, we are interested in its production because we are the principal consumers of abacá fiber. A fiber expert, Mr. M. M. Saleeby, has been employed by the Philippine Bureau of Agriculture in Manila, to devote his entire time to investigations of the abacá industry. He has found that, while abacá may be propagated from seed, and in fact many abacá seedlings grow in the plantations, none of the seedling plants ever develop into a good type like the plants grown from suckers. This fact may be of quite as much value in breeding plants of similar character as it is in attempting to introduce these plants into new localities. We have tried to introduce the plants into Porto Rico by means of seedlings, because the seeds were more easily transported than the suckers, but we have never been successful in securing good plants there."

In the opinion of the other three members of your committee, the breeders of flax need more the plans and specifications from the manufacturers as to what the latter will use in a commercial way.

The breeder has shown that he can produce a 12-inch flax plant or a 4-foot plant, an attenuated plant in its shaft or a tall one which has greatly elongated branches; one that produces three, four, or five stems or one that produces a single stem. He has produced coarse-stemmed and fine-stemmed at will, but the manufacturer has failed to find a way to use the crop of fiber produced at a price for which it can be grown in this country.

With these facts in mind your committee entered on a campaign to learn the status of the manufacturers of linen fabrics in this country with a view to helping them if possible. About twenty flax fiber and tow mills were located in North Dakota within a decade and were favorably situated as regards business concessions from commercial clubs, supply of flax straw, and salvage in the form of flax seed remaining in the straw, but they have all closed down and quit business.

Some firms which claim great recent success and new developments were approached by your committee for information as to their status and what we can do to aid them, but we have met with little success. Some of these firms insist that they have processes completed or nearing completion for retting and handling flax, which will soon revolutionize the fiber business, but these processes are valuable and consequently secret. Your committee believes that further effort along this line should be put forth.

An earlier report from this committee (A. B. A. vol. 4, pages 219-233) indicates that the hemp plant is also very plastic in the hands of the breeder and offers good returns for systematic work which will aid the producers and manufacturers. Both hemp and flax are unusually pliable in the hands of the breeder and should prove good subjects for the man who desires to study methods.

WALNUT-OAK HYBRID EXPERIMENTS.

ERNEST B. BABCOCK, *Berkeley, California.*

EXPLANATORY NOTE.

In the fall of 1907 the attention of the writer was called to certain trees growing in southern California which were locally known as "walnut-oak hybrids." The origin of this name together with a description of one of the trees may be found in Jepson's "Silva of California" (now in press). Before any facts were known which would help to explain the identity of this anomalous form, experiments were begun in the effort to secure data that would substantiate or discredit the hypothesis of origin through hybridization between oak and walnut. It was reasoned that the failure of a large number of careful efforts to secure such a hybrid would discredit this hypothesis, while the production of one such hybrid artificially would tend to strengthen it. The only native walnut of southern California is *Juglans californica* Wats. The oak which was locally considered to be the male parent is the coast live oak, *Quercus agrifolia* Nee.

EXPERIMENTS IN 1908.

Very early in the spring two wild walnut trees were selected. They were located one at the front and the other at the rear of a large city lot in the suburbs of Los Angeles. Through the courtesy of the residents, they have been well protected from any interference during the critical stage of the experiments. They will be designated below as Tree I and Tree II. By March 25 the pistillate catkins could be found terminating the new branchlets of the season. Manilla paper bags were used to cover 50 pistillate catkins on each tree. On April 9 no pollen was being shed on Tree I. Eight bags were left in place as checks. The flowers on 23 pistillate catkins were poliinated with oak pollen obtained from a large acorn-bearing coast live oak tree growing in the neighborhood. The method of gathering the pollen was to hold a wide-mouthed vial so as to include several shedding catkins as they hung on the tree, then tapping the branchlets so as to cause the pollen to fall. In this way sufficient perfectly fresh pollen was secured to treat a large number of walnut flowers by using a camel's hair brush. In the same way pollen was obtained from one of the "walnut-oak hybrids" in Garden Grove, which will be referred

to below as Freak. This pollen was used on 19 pistillate catkins on April 11. On this date also the 50 bags that had been placed on Tree II were opened, except 6 that were left in place as checks. Of the remaining pistillate catkins 27 were abandoned because most of the flowers were still very small, and 17 were pollinated with oak pollen as on Tree I. The conditions on the above dates were nearly ideal; warm, sunny mornings, plenty of fresh oak pollen, and, on Tree I, the pistillate flowers apparently in the proper stage of development, although no pollen was being shed on that tree. On Tree II some pollen was being shed, but care was taken not to expose the pistillate flowers in pollinating them. The results of this work are shown in the following table:

Summary of walnut-oak hybridizing experiment for 1908.

TREE I.

Source of pollen.	Number of pistillate catkins pollinated.	Number of catkins on which nuts formed.	Number of nuts produced.	Nuts that germinated in 1909.	Trees growing in 1909.
Oak	23	14	27	26	24
Freak....	19	8	13	13	12
Checks...	8	0	0	0	0

TREE II.

Oak	17	16	37	33	32
Checks...	5[a]	1	2	2	2

[a] One check missing.

EXPERIMENTS IN 1909.

The same walnut trees were used as in 1908, and extra effort was made to secure good control. It was planned to use pollen from other species of Juglans also. Double thickness oiled paper bags were tied over the new branchlets on March 16. As the season was somewhat later than in 1908, the pistillate flowers were not conspicuous, and, of the 50 bags used on Tree I, only 11, out of 43 examined, were found to contain pistillate catkins, on April 23. Of the 7 left for checks it was found later that at least 4 had covered pistillate flowers, their dried remains being present in the bags. The oak tree from which fresh pollen was obtained in 1908 had quite passed the blooming period by this time so that no pollen could be obtained. The 11 pistillate catkins were pollinated as follows: 8 catkins (18 flowers)

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EXPERIMENTS IN 1908.

Very early in the spring two wild walnut trees were selected. They were located one at the front and the other at the rear of a large city lot in the suburbs of Los Angeles. Through the courtesy of the residents, they have been well protected from any interference during the critical stage of the experiments. They will be designated below as Tree I and Tree II. By March 25 the pistillate catkins could be found terminating the new branchlets of the season. Manilla paper bags were used to cover 50 pistillate catkins on each tree. On April 9 no pollen was being shed on Tree I. Eight bags were left in place as checks. The flowers on 23 pistillate catkins were pollinated with oak pollen obtained from a large acorn-bearing coast live oak tree growing in the neighborhood. The method of gathering the pollen was to hold a wide-mouthed vial so as to include several shedding catkins as they hung on the tree, then tapping the branchlets so as to cause the pollen to fall. In this way sufficient perfectly fresh pollen was secured to treat a large number of walnut flowers by using a camel's hair brush. In the same way pollen was obtained from one of the "walnut-oak hybrids" in Garden Grove, which will be referred

to below as Freak. This pollen was used on 19 pistillate catkins on April 11. On this date also the 50 bags that had been placed on Tree II were opened, except 6 that were left in place as checks. Of the remaining pistillate catkins 27 were abandoned because most of the flowers were still very small, and 17 were pollinated with oak pollen as on Tree I. The conditions on the above dates were nearly ideal; warm, sunny mornings, plenty of fresh oak pollen, and, on Tree I, the pistillate flowers apparently in the proper stage of development, although no pollen was being shed on that tree. On Tree II some pollen was being shed, but care was taken not to expose the pistillate flowers in pollinating them. The results of this work are shown in the following table:

Summary of walnut-oak hybridizing experiment for 1908.

TREE I.

Source of pollen.	Number of pistillate catkins pollinated.	Number of catkins on which nuts formed.	Number of nuts produced.	Nuts that germinated in 1909.	Trees growing in 1909.
Oak	23	14	27	26	24
Freak....	19	8	13	13	12
Checks...	8	0	0	0	0

TREE II.

Oak	17	16	37	33	32
Checks...	5[a]	1	2	2	2

[a] One check missing.

EXPERIMENTS IN 1909.

The same walnut trees were used as in 1908, and extra effort was made to secure good control. It was planned to use pollen from other species of Juglans also. Double thickness oiled paper bags were tied over the new branchlets on March 16. As the season was somewhat later than in 1908, the pistillate flowers were not conspicuous, and, of the 50 bags used on Tree I, only 11, out of 43 examined, were found to contain pistillate catkins, on April 23. Of the 7 left for checks it was found later that at least 4 had covered pistillate flowers, their dried remains being present in the bags. The oak tree from which fresh pollen was obtained in 1908 had quite passed the blooming period by this time so that no pollen could be obtained. The 11 pistillate catkins were pollinated as follows: 8 catkins (18 flowers)

with pollen from *Quercus agrifolia* brought from Berkeley, collected April 20, and on that day giving a satisfactory germination test; 3 pistillate catkins (9 flowers) with pollen from *Juglans sieboldiana* brought from Niles. This was gathered April 19 but not tested. One week after being collected it failed to germinate in 10 per cent sugar solution.

On Tree II, when examined April 24, 23 out of 45 bags covered pistillate catkins, 5 bags being left as checks. The 23 pistillate catkins were pollinated as follows: 3 catkins (9 flowers) with *Juglans regia* pollen gathered in East Whittier on April 22; 3 catkins (14 flowers) with *Juglans sieboldiana* pollen, as on Tree I; 3 catkins (12 flowers) with pollen taken from one of the "walnut-oak hybrids" in East Whittier, on April 22; 7 catkins (36 flowers) with *Quercus agrifolia* pollen from Berkeley, as on Tree I; 5 catkins (17 flowers) with pollen taken from two trees of *Quercus engelmanni* in Sierra Madre on April 23.

No nuts whatever were produced as a result of any of the 1909 crosses. This totally negative result may be partially explained by some of the conditions; for instance, on Tree I, probably the pollen used was too old; on Tree II, the pollen of *Quercus agrifolia* and *Juglans sieboldiana* was the same as on Tree I; the pollen from *Juglans regia* was obtained from catkins that had shed most of their pollen already; the "walnut-oak hybrid" in East Whittier seldom bears nuts and its pollen may be sterile. Only the pollen of *Quercus engelmanni,* which was gathered less then 24 hours before it was used, was abundant in quantity, may be considered as in ideal condition, and this was applied to only 17 flowers. It is hoped that, during the coming spring (1910), similar experiments may be carried out on a large scale, with proper observations on pollen germination. Any suggestions from those interested will gladly be received.

SUPPLEMENTARY NOTE (May 1910).—There are now 151 nuts developing in the two walnut trees at Garvanza, as the result of pollinating 79 pistillate catkins with pollen from *Quercus agrifolia* as in 1908. There are also 29 nuts as a result of pollinating 16 pistillate catkins with pollen from *Quercus engelmanni* as in 1909.

The behavior of the seedlings secured from these nuts, as well as the 1908 seedlings now growing, will be carefully observed. Cions will be grafted on thrifty walnut trees in order to induce early fruiting and thus secure second generation trees as soon as possible.

[Presented by Committee on Breeding Nut and Forest Trees.]

REPORT OF COMMITTEE ON BREEDING CEREALS.

C. A. ZAVITZ, *Guelph, Ontario, Chairman.*

MEMBERS.

Prof. Alvin Keyser, Ft. Collins, Colo.
Prof. L. S. Klinck, Macdonald College, Quebec.
C. G. Williams, Wooster, Ohio.
M. A. Carleton, Washington, D. C.
Dr. C. E. Saunders, Ottawa, Canada.
Prof. J. H. Shepperd, Agricultural College, N. Dak.

OBJECTS.

The duties of this committee shall be (1) to investigate and report on the methods and technique of improving the cereals by breeding, and (2) to encourage the production of improved varieties of all the cereals for each agricultural region and for each use.

PLAN.

The committee on the breeding of cereals desires to have the work conducted along as definite and systematic lines as possible. We believe it is a good plan for breeders and breeding establishments to conduct the work with the different species of field crops along some general plan, such as the one here indicated.

Status of the species.
Physiological facts to be considered by breeders.
Strong economic characters.
Characters needing improvement.
Securing foundation stocks.
Plan of breeding.
Testing progeny.
Distribution of improved strains.

This outline has been suggested, not only to breeders, but to those who are to present special papers at the annual meeting.

In order to ascertain what is now being done at various institutions in the line of plant breeding, the chairman of the committee wrote to about sixty experiment stations, as follows:

I would greatly appreciate receiving a concise statement of the work which is being done at your institution in the breeding of cereals, especially along the following lines:

1. The main objects in view.
2. The outline of what is being done.
3. The method of operation.
4. The most important results which have already been obtained.
5. The name of the person directly in charge of this work.

The greater number of the institutions have already been heard from, and when all have reported some most excellent information will be at hand for assisting in the future work of the committee.

PAPERS PREPARED.

The papers which have been specially prepared for presentation at the annual meeting for 1909 are as follows:

The Breeding of Barley, Prof. J. H. Shepperd, Agricultural College, N. D.; Prof. Alvin Keyser, Ft. Collins, Colo.
Wheat Breeding, Prof. H. F. Roberts, Manhattan, Kans.
The Breeding of Grain Sorghums, C. R. Ball, Washington, D. C.
A Large and Small Grain Experiment, Supt. R. L. Waldron, Dickinson, N. D
The Problem, its Limitations and Possibilities, R. Gauss, Denver, Colo.

BREEDING FOR TYPE OF KERNEL IN WHEAT.

HERBERT F. ROBERTS, *Manhattan, Kans.*

Considerable attention has been devoted to the breeding of a particular type of kernel in corn, but, to the writer's knowledge, nothing has hitherto been done to ascertain the most desirable type of kernel in wheat, as judged from the economic standpoint, or to breed for such a type.

The present paper proposes to discuss the results of a preliminary investigation directed toward this end.

In the first place, so far as the miller is concerned, there are certain well-defined preferences with respect to a desirable wheat for milling purposes. Leaving out the primary necessity, in our region at least, of a hard semi-translucent wheat, rich in gluten and preferably a winter wheat with a dark reddish-amber color, we find that, so far as the form of the wheat kernel is concerned, the millers and grain dealers desire a full, plump berry in preference to a slender berry, on account of the relatively smaller proportion of bran which such a kernel produces; and, for the same reason, a berry with a shallow crease is preferable to one with a deep crease. The deep crease is also an objectionable feature because of the considerable quantity of dirt that it holds, which must be cleaned out in the scouring process as thoroughly as possible. A type of kernel devoid so far as possible

of the mass of hairs surmounting the ovary, called the "brush," is likewise desirable because of its lesser liability to carry dirt particles. So much for the preferred type of kernel for milling purposes.

The present investigation, however, was directed in part, and so far as the data to be herein presented are concerned, toward another matter, namely, the relation of the form-factors of the wheat kernel to the volume-weight of the grain.

Wheat, before being sold, is "tested" by means of a standard "grain tester" in order to ascertain the number of pounds per bushel it will average. Upon this average bushel-weight and upon other considerations affecting the quality of the grain as judged by its appearance, hardness, etc., the grain is "graded" according to the system of standards prescribed by the grain exchange or the State inspection department as the case may be. The grade as thus fixed for any lot of wheat determines its market price. Wheat is, to be sure, sold entirely by weight in our market, but if two lots of wheat weigh 1,000 pounds each, and one tests at 56 and the other at 62 pounds to the bushel, the latter will bring the higher price (at present, in the neighborhood of 5 or 6 cents more per bushel).

What factors determine the differences in volume-weight which thus affect the selling price of wheat? On first consideration it would naturally be assumed that the specific gravity of the kernels would be the most important factor.

However, it was noticed, that, among several hundred pure races, originating from single mother plants, of wheat harvested in 1908 at the Kansas Experiment Station, certain distinctive types of kernel existed, which seemed to pack more closely into a given volume than did others, and an investigation was instituted to determine the optimum type of wheat kernel in this regard. To this end, 52 pure lines of wheat were selected, which seemed to afford a series of very diverse types of kernel in respect to length, width, contour, etc.

From each of these races, five series of 100 kernels each were taken by random samplings. In each series of 100, the average length and average width of the kernels were determined. It was found that the variations in averages among the five different hundreds of each lot were so slight that in general a lesser number than 500 would have sufficed. However, this number was adhered to in the determination of the averages in question for the entire series of 52 races. The ratio of length to width was taken as a form-factor—a large ratio

denoting a long grain and a small ratio a short grain, as a matter of course.

The determination of the average volumes of the kernels (by displacement of 95 per cent alcohol in a burette) gave a means of differentiating, say, two races having the same length-to-width ratios, but in which the kernels were of different average size.

The volume-weight of the kernels of each race was then determined by weighing as much grain as could possibly be packed into a 250-cc graduate, the packing being effected by vigorously tamping the graduate a given number of times for each fractional portion of its contents as the same was put in. This volume-weight in grams per 100 cc will be converted into terms of pounds per bushel for the purpose of this paper.

The amount of unoccupied air space left among the kernels of the packed grain was then determined in the case of each of the 52 races in the experiment, by filling the graduate, in which the grain had been packed as described, with 95 per cent alcohol. The amount of alcohol thus delivered from the burette, and necessary to exactly cover the grain, reduced to a basis of 100 cc and subtracted from 100, gave exactly the percentage of actual solid grain material in each case.

There were thus at hand data for determining the relation between any specific type of kernel as expressed in terms of the length-to-width ratio and the average kernel-volume on the one hand, and the percentage volume of grain in 100 cc on the other; and between all of these factors on the one hand and the bushel-weight on the other.

The full details of the methods followed, as well as the complete tables of the experimental data, are reserved for a bulletin prepared by the writer for the Kansas Experiment Station.

In the figure on page 207 is shown the relation of the form of the wheat kernel expressed in average length-to-width ratios, to the packing of the grain as expressed in the percentage volume of grain in 100 cc, where all of the 52 races of wheat in the experiment are taken without reference to average kernel-volumes.

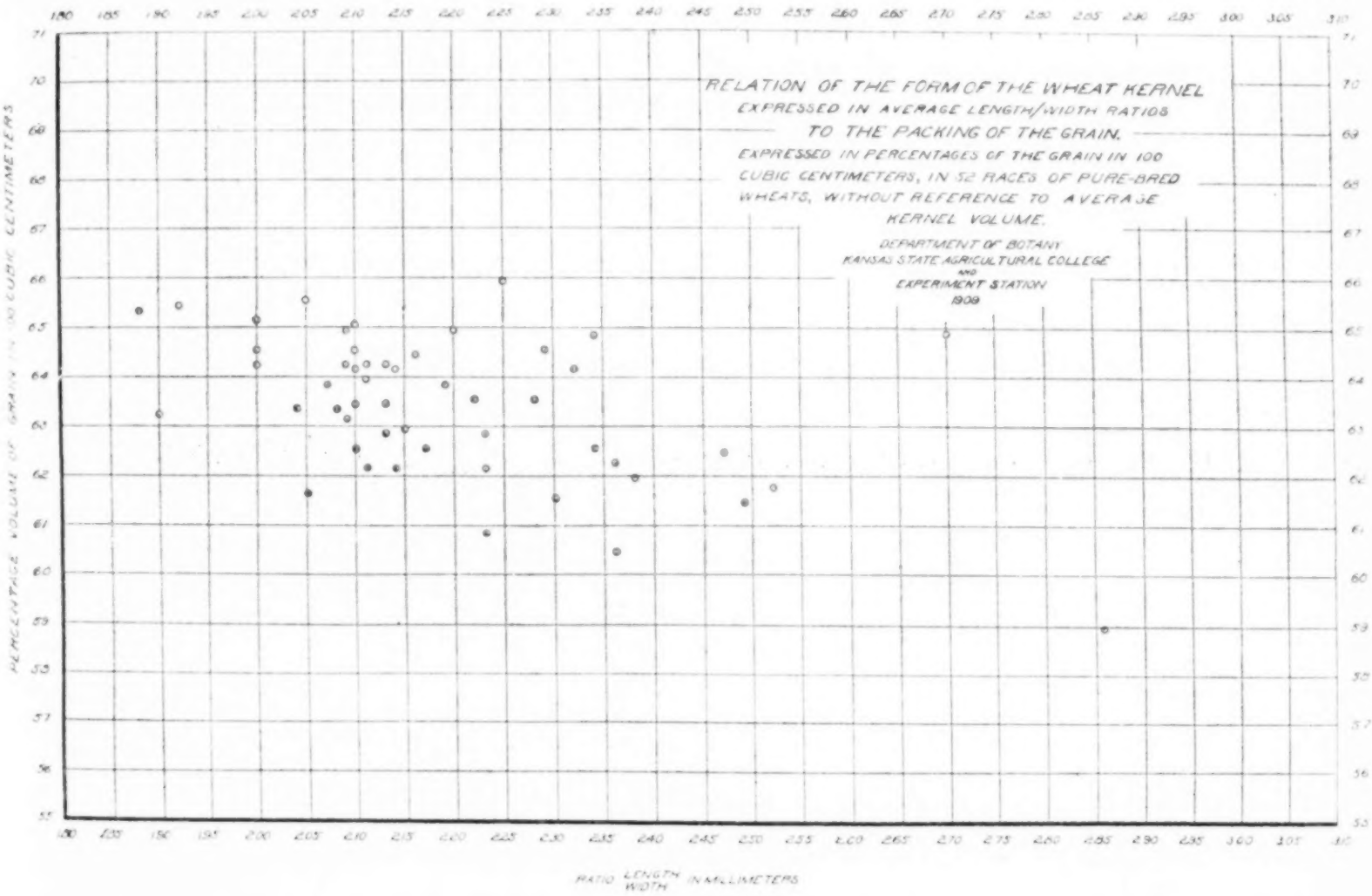
Abscissæ denote the average length-to-width ratios of the kernels; ordinates denote the percentage volume of grain in 100 cc.

The plotted data indicate very plainly that as the length-to-width ratio increases the percentage volume of grain that can be packed into 100 cc diminishes, irrespective of the actual size of the kernels as expressed by their average volumes.

In the figure on page 208 is shown the relation of the size or average volume of the kernel in the same 52 pure strains of wheat to the packing of the grain as expressed by the percentage volume of grain in 100 cc.

Here the abscissæ denote average volumes of the individual kernels in cubic millimeters; the ordinates denoting again, as before, the percentage volume of grain in 100 cc.

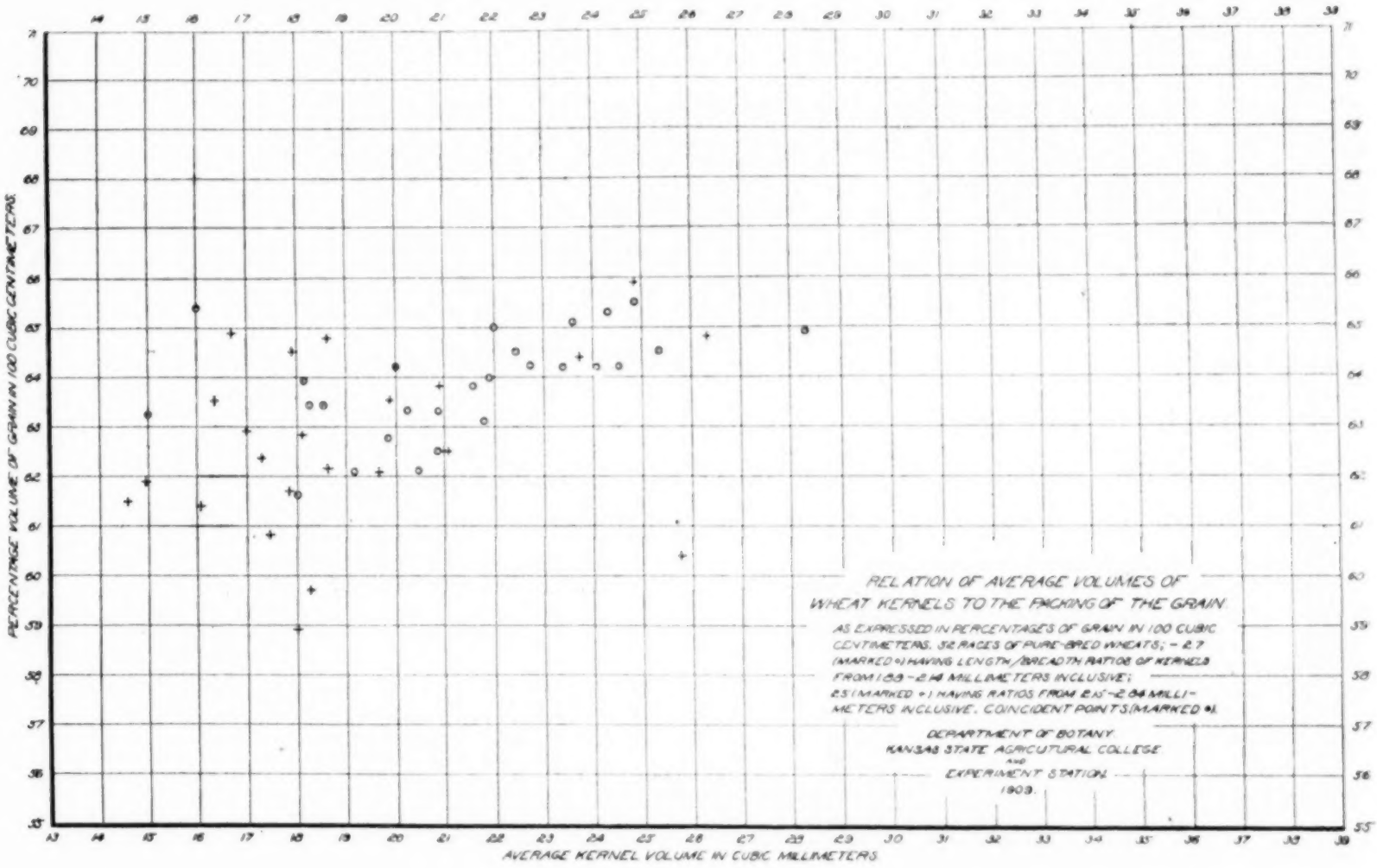
Here the plotted data indicate even more plainly the fact, that, with the increase in the average volume of the individual kernel, there is a corresponding increase in the percentage volume of grain that can be packed into 100 cc.


RELATION OF THE FORM OF THE WHEAT KERNEL
EXPRESSED IN AVERAGE LENGTH/WIDTH RATIOS
TO THE PACKING OF THE GRAIN.
EXPRESSED IN PERCENTAGES OF THE GRAIN IN 100
CUBIC CENTIMETERS, IN 52 RACES OF PURE-BRED
WHEATS, WITHOUT REFERENCE TO AVERAGE
KERNEL VOLUME.
DEPARTMENT OF BOTANY
KANSAS STATE AGRICULTURAL COLLEGE
AND
EXPERIMENT STATION
1909
PERCENTAGE VOLUME OF GRAIN IN 100 CUBIC CENTIMETERS
RATIO LENGTH / WIDTH IN MILLIMETERS

Since this is not what we should have been led theoretically to expect, it was determined to analyze the data somewhat further, eliminating if possible some of the variables, so that the relation between the average kernel volume and the packing of the grain, as expressed by the percentage volume of grain which would go into 100 cc, might be more clearly seen.

All of the cases having like length-to-width ratios of kernels were taken together, making a series of 12 pairs. In 6 of these pairs the higher percentages of grain containable in 100 cc of space followed the higher average kernel-volume; in the other 6 pairs the reverse was the case. In general, however, it occurs that in the cases with the

lower ratios, *i. e.*, the shorter kernels, the correspondence of good packing quality, as expressed by the percentage of grain containable in 100 cc, with the higher average kernel-volume, *i. e.*, with the larger-sized kernels, seems to be more marked than in the cases of the high ratios, *i. e.*, of the long kernels. The data on the whole are too few to warrant any general conclusions, but the results thus far seem to indicate that the large-kernelled races of a wheat with short grains will leave the least waste air-space in a measure, or, in other words, will pack the bushel most perfectly.


PERCENTAGE VOLUME OF GRAIN IN 100 CUBIC CENTIMETERS
AVERAGE KERNEL VOLUME IN CUBIC MILLIMETERS
RELATION OF AVERAGE VOLUMES OF WHEAT KERNELS TO THE PACKING OF THE GRAIN.
AS EXPRESSED IN PERCENTAGES OF GRAIN IN 100 CUBIC CENTIMETERS. 32 RACES OF PURE-BRED WHEATS; - 27 (MARKED +) HAVING LENGTH/BREADTH RATIOS OF KERNELS FROM 1.89 - 2.48 MILLIMETERS INCLUSIVE; 25 (MARKED +) HAVING RATIOS FROM 2.45 - 2.84 MILLIMETERS INCLUSIVE. COINCIDENT POINTS (MARKED ●).
DEPARTMENT OF BOTANY.
KANSAS STATE AGRICUTURAL COLLEGE
AND
EXPERIMENT STATION.
1909.

Now what relation does this have to the volume-weight as expressed in pounds to the bushel? The manner of determining the volume-weight has already been described.

Taking again all of the cases under experiment, where like length-to-width ratios of kernels existed, and plotting as abscissæ the average volumes of the individual kernels in increasing order, and with three sets of ordinates, denoting respectively pounds per bushel, percentage volume of grain in 100 cc, and average kernel-weight, it appears from the data that in every case of like ratios the bushel-weight follows the percentage volume of grain in 100 cc rather than the average kernel-weight. Where this percentage volume increased, the bushel-weight increased, and where the volume of grain in 100 cc decreased, the bushel-weight decreased, almost absolutely independently of the aver-

age weight of the individual kernels, which sometimes rose and sometimes fell.

This is not what would perhaps have been expected, and the small number of cases having like ratios makes a general conclusion of rather doubtful value. The facts thus far, however, seem to point to the following as inferences from the experimental data.

1. The shorter the wheat kernel and at the same time the larger its volume, *i. e.*, the more nearly it approaches the sphere in form, the more perfectly will the kernels pack, and the less air-space unoccupied by the grain will be left in the measure.

2. Where the kernels are long, increased average kernel-volume does not insure increased solidity of packing to the measure, but rather the reverse.

3. In general the long types of kernel pack less perfectly than the short types, and should be discarded by breeders in favor of the latter, where pure-bred wheat races are in question.

[Presented by Committee on Breeding Cereal Crops.]

ACCLIMATIZATION IN BREEDING DROUGHT-RESISTANT

ROBERT GAUSS, *Denver, Colorado.*

The dominion of climate is invincible. All who come within its range must obey its laws. It grants no pardon. It makes no compromise. Compliance with the conditions imposed is the license to exist, and these conditions determine the limits of activity. Even the achievements of irrigation are the fruits of constant warfare. Every irrigated field is territory wrested from this dominion and maintained by unceasing effort and never failing vigil. The city of Denver preserves its beauty and its charm by constant struggle against the ever encroaching desert, which, encamped and entrenched, maintains sleepless siege against the town. The desolation of Nineveh and the ruin of Babylon are evidence rather of surrender to an adverse climate than of destruction wrought by the hand of man. Thus the testimony of history and the witness of nature demonstrate the truth of Montesquieu's declaration that the most enduring of all empires is the empire of climate.

Acclimatization and naturalization are two radically different methods of introducing new varieties and species. Naturalization is the introduction of plant species from foreign countries where they have become adapted to climatic conditions closely resembling those of the region to which they may be transferred. Were it practicable to find in other lands valuable species so drought-resistant that they would thrive in the arid places of this country, the problem of acclimatization could be laid aside, for its solution elsewhere would render needless its investigation here. But the fact that no such adapted varieties of the common cereals and other valuable crop species can be found makes acclimatization the supreme problem of the arid West.

Wallace defines acclimatization to be "the process of adaptation by which animals and plants are gradually rendered capable of surviving and flourishing in countries remote from their original habitat or under meteorological conditions different from those which they have usually to endure, and which are at first injurious to them." This definition contemplates not only complete acclimatization, but also those slight changes in constitution which enable a plant to endure a moderate climatic difference without the development of new specific characters. Thus one variety may be more drought-resistant than another, and it may have acquired this power by slight variations which would probably disappear upon transfer to a humid environment. Between such varieties and those less drought-resistant members of the same species which have always enjoyed the advantage of abundant moisture, there is not that specific difference which separates the plants of distinctly desert regions from those of distinctly humid regions. Complete acclimatization from humid to desert conditions involves the development of new specific characters.

That degree of acclimatization which involves the development of distinctly desert species is by some naturalists looked upon as chimerical. Prominent among these is Professor de Vries, the eminent Dutch botanist, whose writings form, probably, the most notable recent contribution to the doctrine of evolution. In a little book entitled "Plant Breeding," he expresses the belief that the desert species in the intensely arid region of southern Arizona acquired their drought-resistant qualities by mutations which occurred under humid conditions, that they were expelled from the humid environment, that they reached the desert by migration, and that the desert environment had nothing to do with their evolution.

This theory ignores the fact that adaptation is not found exclusively in the occurrence of a favorable mutation, but in both the occurrence of the mutation and its subsequent perpetuation. One might admit that a drought-resistant mutation could arise under humid conditions, but one could not admit that a mutation of that kind would be an advantage unless there were drought to be resisted. Were a drought-resistant mutation to occur in a region of abundant moisture, it would be a disadvantage, and hence, in all probability, it would disappear before the species could escape by migration. It is only when a mutation is in harmony with the environment that it gives the plant in which it occurs any advantage; and since it is through the advantage given individual plants by this harmony that natural selection operates, the guiding factor in the perpetuation of drought-resistant mutations must be the arid environment to which they conform. Thus the desert, acting as a sieve, determines that drought-resistant plants shall live and that non-drought-resistant plants shall die. From this we are bound to conclude that as a rule desert species have been developed in desert regions.

The assumption which many writers make—among them De Vries—that nutrition can be distinguished from climate in the effect upon plant growth, involves a serious as well as common error. In fact it is impossible to distinguish them, for nutrition and climate can not be separated. In the case of all vegetable organisms, nutrition is the process by which they absorb nutriment and transform it into living tissue. They do this, subject to conditions of heat, light, and moisture. But a prevalent combination of heat, light, and moisture in nature is what we call climate. Hence climate is a factor in nutrition and a measure of the ability of a plant to utilize the nutriment within its reach. A favorable climate stimulates, an unfavorable climate restricts nutrition. The all-important thing to consider is that aridity puts, as it were, hobbles upon nutrition. It is the aim of acclimatization to overcome these restrictions and enable the plant to carry on the work of nutrition in spite of the lack of water.

The way in which aridity restricts nutrition is disclosed by the fact that the service performed by water is almost exclusively mechanical. It holds in solution the nutriment in the soil, conveys it through the roots to the plant tissues, and by keeping the tissues moist facilitates the requisite physiological processes. Ordinarily, a reduction of the supply of water would reduce the nutriment and

restrict physiological activity. In the case of desert plants structural adaptation overcomes this in a measure and enables them to get greater service from the water which is available than they would without this adaptation. The fact that the water which is not retained in the plant is returned to the air by transpiration presents the possibility of a special adaptation. By this act of transpiration a plant may lose a great deal of the moisture taken into its system; and hence a structural adaptation which would check needless transpiration would promote economy in the use of water. The problem of acclimatization is to secure this and other desirable changes in structure.

One should not conclude, however, that in relation to profitable agriculture the possibility of successful acclimatization to arid conditions is confined to the development of direct modifications of the kind in question. For the argument's sake, one might admit that there would be a reduction in the aggregate growth of a plant in consequence of a reduction in the available quantity of water, although observation shows that it is really much less in the case of a plant with drought-resistant adaptations than in one not so adapted. While admitting for the argument's sake the reduction of growth, one should take into consideration the conflict between vegetal growth and reproduction, which has been recognized by botanists since the beginning of vegetable physiology. The circumstances under which this conflict becomes manifest were elaborately presented by Herbert Spencer nearly sixty years ago in one of his most interesting contributions to the theory of evolution. Botanists may differ in regard to the exact nature of the conflict; but that it exists and is closely associated with nutrition is beyond dispute. When nutrition is strong, showing itself in large vegetal development, reproduction is relatively less active; but when a check is placed upon vegetal growth, reproduction sets in. Mr. Patrick Geddes, the British botanist, has given this subject much attention, and he is one of the leading advocates of the proposition that the conflict in question plays a highly important rôle. Arthur, quoted by Professor Bailey in his work on plant breeding, says: "A decrease in nutrition during the period of growth of an organism favors the development of the reproductive parts at the expense of the vegetative parts." Although the case presented is not exactly parallel to that of plants subjected to unbroken poverty of nutrition from the beginning of their lives, the same discrimination

seems to take place when an entire species is compelled to struggle against adverse conditions. In the latter case, natural selection seems to have preserved or perpetuated a tendency to favor the reproductive. In any event, whatever favors the reproductive functions is of advantage to agriculture. Aridity may restrict the aggregate growth, but through a relatively large yield of grain discrimination in favor of reproduction may leave a margin of profit to the farmer. In further support of this view, I may point to the fact within the observation of nearly all wheat growers that a heavy growth of straw is often followed by a disappointing yield of grain, whereas an unpromising development of straw frequently precedes a harvest which yields much more than the appearance of the crop indicated.

In passing, I may remark that if the line of acclimatization is through deterioration, affecting chiefly the vegetal development, but from which the reproductive would not be exempt, the effect upon wheat would probably be seen in a reduction in the size of the grains. If this assumption is correct, small grains might be a mark of acclimatization which the breeder should not ignore.

The methods to be pursued by the breeder now demand consideration; and in this connection I find myself heavily indebted to Professor de Vries, for he has given me a new weapon with which to combat his theory that acclimatization is a dream. One who may be engaged in breeding drought-resistant cereals will have to conduct his experiments only a few years to discover that the desired end is not to be attained by adding one favorable variation upon another. When I began my experiments in 1896 I thought that could be done; but in course of time I discovered that, whereas in one year a plant might show a variation in what might seem to be the right direction, its offspring the next year might just as effectually vary back to the original standard and obliterate all that had been gained. Thus the breeder might find himself swinging like a pendulum between narrow extremes of variation without making any progress. I must confess that, when I was at that stage of my work, I knew nothing about the vicious circle of fluctuating variations concerning which Professor de Vries has so instructively written. There is little hope in the struggle with fluctuating variations. But by his theory of mutations Professor de Vries has pointed out the path of possible escape from the entanglement; and I am now convinced that the acclimatization

of cereals to our arid climate can be accomplished by taking advantage of favorable mutations. But while in theory this simplifies the problem, it greatly increases its practical difficulties. It removes the work to be done from the domain of agricultural to that of botanical experimentation. Solution of the problem calls for a large and fully equipped experiment station, ample funds for carrying on the work, and a force of botanists and other trained men to conduct the experiments. Of the truth of this I am fully convinced by both observation and personal experience. While recognizing that in my own field work I have not solved the problem of acclimatization, I think I have learned something about its nature. My investigations have convinced me that the end to be attained is beyond the reach of individual effort. The work should be done by the Government; and, since the problem is distinctly scientific in character, its solution should be intrusted exclusively to botanists of experience and proved ability. In the hope that in this spirit the work will be done, I look upon it as extremely fortunate that the Department of Agriculture has taken it up. The regret I shall feel in severing my own connection with work of this kind—which I shall have to do in the near future—will be greatly offset if my views respecting the nature and importance of the problem find acceptance. There is reason to fear, however, that a good deal of the labor at the experiment stations now maintained by the Government may be in vain so far as the problem of acclimatization is concerned. Growing numerous small plats of wheat does not hold out much promise of success. Possibly a comparison of yields may show some superiority in one variety over another; but a great deal more than that is needed. The problem is radically different from the one which presented itself to Mr. Hays when he was making his highly successful and instructive experiments to improve the wheats of Minnesota. Acclimatization was not even a factor in his problem. It is the whole problem here. Were we in possession of a fully acclimatized species of wheat, there would probably then be call for experiments like those conducted by Mr. Hays, in order to improve the species and secure a larger yield.

Probably the first thing requisite is full, clear recognition that acclimatization is in reality the problem to be solved, and that its solution calls for distinctly botanical investigations. I fear that at least some of the government experimenters are struggling with the

fluctuating variations of which I have spoken. In their case there is need of recognition that it is only through the discovery of mutations that they can hope to succeed. What is required is the discovery of a new elementary species, drought-resistant in characters distinguishing it from species adapted to a humid climate. It would probably require the trained eye of a botanist to discern these specific characters or differences; but, however this might be, the mutations giving rise to such characters will, in my opinion, have both to occur and to be perpetuated, before acclimatization to an arid environment will be fully accomplished. That mutations of this kind occur from time to time is highly probable; and so my advice to the experimenters is to look for "sports." But let them recognize that a sport showing adaptation to aridity would probably present a very different appearance from that of a sport in a region of abundant moisture. It might, measured by humid region standards, be a most unpromising looking plant—the "singed cat" of the entire field. Probably it would be short in stature, present a dense as distinguished from an open growth, possess a large though short stem, thick coarse leaves and a big development of root. In many respects the last named may be the most important. Neither late-maturing nor early-maturing plants should be rejected. The former might show greater adaptation to aridity; but if the latter should show a special adaptation to the length of the rainy season, they might prove to be very valuable from the standpoint of practical agriculture, although scientifically less interesting than the others.

One obstacle in the path of a breeder compelled to conduct his experiments upon a restricted scale is the comparatively small number of plants available for examination. There is more hope of finding the desired mutations among tens of thousands of plants than in little experimental plats. Should the Government do the work, it could afford to grow five hundred thousand individual wheat plants, if Burbank could grow ten thousand shrubs in the hope of finding a single one with the desired character. The individual plants should be grown sufficiently far apart to give room for careful examination, and they should be numerous enough to give hope of finding the desired mutation. Extensive experimental planting is a prime requisite; for it is not by a kind of training process that acclimatization is to be achieved, but by actually going out and finding the mutations in case they occur.

This leads to a suggestion respecting a way in which success might be achieved. Sheriff, the famous British breeder of fine wheat varieties, devoted his time to looking for sports in the fields, and sometimes years elapsed after finding one before he found another. But from sports discovered by him several superior kinds of wheat arose. Some of the best wheats now grown in the United States are products of similar discoveries. Bearing this in mind, and while still asserting that acclimatization is a botanical and not an agricultural problem, I may consistently suggest that any intelligent and observing man engaged in growing cereals in the arid region by the more or less precarious methods of "dry farming" might stumble upon the desired sport. Hence all dry farmers should be encouraged to look for mutations or sports of that kind. In order that they might search intelligently, it would be well if the Department of Agriculture were to publish a bulletin containing information on the characteristic appearance of drought-resistant plants, which could be distributed among the dry farmers of the arid and semi-arid regions.

One other suggestion to the Department of Agriculture remains to be made. The greatest thing which has ever been done for the study and investigation of arid region plant growth is the establishment of the desert laboratory near Tucson, Arizona. It was established upon the suggestion and under the direction of Mr. Frederick Coville, botanist in the Department of Agriculture, and Mr. Daniel T. MacDougal of New York, both of them botanists of ability and distinction. In the maintenance of that laboratory an example is set which the Department of Agriculture should follow in connection with the endeavor to breed drought-resistant cereals and other valuable crop species. As I already have said, the problem is botanical. It needs botanists for its solution. At one of the arid region experiment stations—and I know of none more suitable than the one at Akron, Colorado—a botanical laboratory should be established. This laboratory should be the center from which all the acclimatization work should radiate. Every supposed "sport" or mutation, whether discovered at the station or in the field of a dry farmer, should be subjected to careful examination; and no doubt much could be done in that way to determine its real value in respect to drought resistance. Mr. Coville did a splendid thing when, in connection with Mr. MacDougal, he secured from the Carnegie Institution the means and later established the desert laboratory near Tucson, Arizona. I should like to see

him follow up that achievement by organizing under the Department of Agriculture a similar laboratory for experiments in acclimatization under the comparatively moderate desert conditions of this part of the country.

Let no one look with indifference upon the possibility here outlined of acclimatizing valuable crop species to arid regions, or underestimate the magnitude of the achievement suggested. The problem itself is as full of interest to the biologist as the possibility of its successful solution is rich with the promise of benefit to mankind. Excluding the untillable mountains and the hopelessly irreclaimable deserts, acclimatization of the food cereals would make arable nearly 300,000 square miles of the now arid part of the United States, increase by thousands of square miles the productive area of Canada, solve some of the pressing problems of agriculture in German Southwest Africa and the South African possessions of Great Britain, extend far into the interior the tillable area of Australia, and by increasing the yield of the fields expel the specter of famine from the grain regions of southeastern Russia. So vast an achievement would rank with the discovery of a new continent in its enlargement of the sources of human subsistence; and well might the hope of success quicken the activities of the most sluggish and awaken ambition in the least daring.

[Presented by the Committee on Breeding Cereals.]

EDITORIALS

Need of Members.

The *American Breeders Magazine* is passing through its period of trial, of experimentation as to the makeup of its subject matter, and as to its editorial arrangement; also as to suiting the views of the members of the Association. Clearly the scientific papers presented by the members at the annual meeting and those written especially for the *Magazine* should constitute the bulk of the *Magazine*. That portion of the *Magazine* is largely the result of new research. It is the vanguard of new thought on heredity and breeding. It is the applied science of the investigators.

Since the larger body of the membership can not be scientists, but must come from practical breeders of animals and plants, there is need of subject matter in which they are individually interested. The historical sketches in the front part of the *Magazine* will interest many, as will also the notes and news in the back part. The section set apart for editorials gives opportunity for expression on timely topics of general interest to breeders. And here it is designed that there shall be spun the general threads of this whole discussion. The broad philosophy of breeding stated in popular terms will form the woof into which the scientific articles will be woven, each part serving as a part of the web in making up the whole fabric of fact.

The Association will expand the quarterly *Magazine* into a monthly as soon as the financial income will provide the expense. A monthly magazine of the character already established and a bound annual report—which receives high praise everywhere—appear to be a large return for a two-dollar membership fee. But it now seems easily possible to include both of these, and eventually to enlarge the Annual Report to a book of five or six hundred pages, thus placing in bound form the most vital body of knowledge on heredity and breeding. The achievements of modern publishing make this seem entirely feasible. Once the Association has ten thousand members its own income will enable it to successfully make a campaign for a hundred thousand members. A hundred thousand members will carry American plant and animal breeding forward past all obstacles toward adding the possible billion dollars more to the nation's annual crop of raw products of food and clothing.

The American Breeders Association is a voluntary cooperation. It is the opposite of a corporation. The officers lead this cooperation without pay except the satisfaction of seeing it succeed. The teething stage of the Association has long passed. Its lusty growth shows that the youth is coming to a large majority. The annual meetings, the Annual Report and the *Magazine* have all become successful. No one need doubt the future of the Association, nor indeed stop short of large hopes for this movement to conserve and utilize the mutating heredity of the rare plants or animals which, with almost no cost, will add a billion each year to our farm products.

The time has come for the members to become full-fledged co-operators in this movement. The only way to do this is to work. And aside from writing articles, the big work for each and every member is to add to the membership. At the last annual meeting forty-four men promised to secure eleven hundred new members. Some have secured all they promised and more, others have made good progress. There is until February first to make the promise good, and we believe every one will reach at least the full quota promised. And the *Magazine* now appeals to members who were not at that meeting.

Induce friends who should do so to join, you or they sending the two dollars annual membership fee or the twenty-dollar fee as is convenient. Write to friends inviting them to become members; and at the same time write the Secretary of the Association to send a letter seconding your invitation. Ask for small folders to be inserted in your letters to breeders, and where proper to do so close your letters with a sentence calling their attention to the invitation to become a member. Indifference will not compete with other societies which seek members. With a large membership all the rest is possible. That the members can secure other members is being proven by those who made the pledges at Omaha. The Secretary assumed to secure one member for each four secured by others making promises, and his quota is already filled.

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Aims of the Magazine.

The American Breeders Association has assumed the important function of bringing the practical breeders into closer touch with the scientists, and the scientists into a clearer knowledge of the practical problems of the plant and animal breeders. Its meetings have proven the value of an open forum where practical and scientific men interested in breeding

can discuss heredity and breeding in all their relations to the living forms as found in nature and in reference to the production of races of plants, animals, and men with better heredity. The Association assumes the publication of the *American Breeders Magazine* because it feels that there is need of an independent open court for public expression published by a cooperative organization. The Council, under the authority of the Association, in deciding to extend this forum in the form of a magazine realizes both the difficulties and the possibilities of such a step. The effort will be to sustain a high standard of scientific excellence, and at the same time produce a readable magazine. The Association has not been organized to forward the interests of any group of men, but will give a fair and open hearing to all. It aims to achieve scientific and economic results of the highest order and of the widest scope.

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History Repeating Itself.

In the early days of history, when law had much less hold upon men than now, shrewd statesmen and priests ruled the masses through religious customs and observances engrafted upon practically all institutions and acts that concerned the common good. Prominent among these were the agricultural activities such as seed sowing and harvesting and the setting apart of the seed for the next year's crop. With some tribes the rites and functions connected with these events were most elaborate and impressive.

That history repeats itself, that customs though modified move in cycles, is illustrated in a recent proclamation by the Governor of Minnesota to the farmers of that State to set apart the week beginning September 12 as "seed-corn week." Surely this completes a cycle in agricultural history in America. It may be that the beginning of the cycle dates back to the dim era of the mound builders coming up through the Zuni and Mayas and Aztecs to the present silo building, milk separating, auto driving and telephone using American farmer. This modern setting apart of a time for seed saving has been developed through the efforts of the agricultural extension divisions of the State colleges. It differs from its prototype in that it is less compulsory, being no longer a religious rite. It differs also in that it is carried out not alone by the leaders but by the whole people, who appreciate the

science of seed selection. It recognizes, however, that most people need to be led into being thrifty, into preparing for a rainy day by saving in the autumn a plentiful supply of seed for the time of planting.

And in a large sense the choosing of viable seed of the best heredity and preserving its full vitality for the coming year's crop is not merely a matter of duty to self and to family. With the rise in prices of food it has become an affair of State and of Nation that each individual part of our great agricultural machine do its work well, that food may be abundant and cheap for all. The States and the Nation cooperating are doing a great work in inducing tens of thousands of boys on American farms to enter corn-judging and corn-growing contests. The part which thousands of rural district schools, hundreds of consolidated rural schools and agricultural high schools, also collegiate short courses and farmers' extension departments, are doing to teach the selection of seed corn is also productive of large results. Science is taking the place of mere formal rites and the increased production which is coming from the scientific breeding of corn and other seeds is beginning to mount up to large aggregate figures.

To plant over 100,000,000 acres of corn next year our farmers must store tens of millions of bushels of seed corn. Half a billion bushels of corn annually depend on the selection of seed corn of good heredity so preserved that each kernel will grow. To get a full crop each hill must have two or four stalks so bred as to produce on each stalk a large ear or two ears. In the light of these facts the saving of seed corn certainly looms up as a most stupendous breeding operation and one that is well worthy of the proclamation of the Governor of a great State. It is well worth observing by the large farming constituency of Governor Eberhardt and is well worth perpetuating as an "agronomic cult," as it was among the ancients.—GEORGE W. KNORR.

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Heredity in Man.

Records of the efficiency of pupils in our schools, of their success in later life as members of society, and of the potency with which parents project efficiency into their progeny, would, if carefully tabulated, provide data which would induce the more rapid increase of the more efficient strains of human blood and also bring about the less rapid multiplication of the less efficient strains. Work already accomplished under scientific direction in plant

and animal improvement has done much toward providing satisfactory methods of recording and tabulating such data.

Now that compulsory education in many places brings nearly all youth under such conditions that their school-working abilities can be determined, very useful data may easily be recorded; and as our schools are further developed so that the manual as well as cultural studies are included, the abilities of the youth can be judged more completely and more in relation to adaptability to particular vocations, especially to the practical life of the farm, the shop, and the home. It is entirely practicable to record the personal life efficiency of each pupil; and under careful development such a plan of school records may lead to wide cooperation in making such records privately, or even in making publicly accessible the records of the characteristics and efficiency of each and every person in the country.

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The accumulation of efficiency records of large numbers will make possible the tabulation of such efficiency in family records.

Efficiency Records of People.

From a study of such records may be determined the nature of inheritance of efficiency; and (approximately) the power or value of each individual as a prospective parent of efficient children. Such records would show which are the more efficient races, families, and individuals, upon whom, under suitable social and political conditions, the burden of abundant child-bearing might be made to rest. Definite knowledge of this kind would conceivably give the less efficient races and strains of men a feeling of less responsibility in the maintenance of a large progeny, while in families where the parents represent high hereditary efficiency, and especially in families which also occasionally produce geniuses, it would undoubtedly add greatly to the desire for a goodly number of children. Again, it would presumably greatly deter from abundant child-bearing those families in which the expectancy of efficiency is low; and it ought especially to do so in those cases in which defective and criminal children occur. It seems clear that since the public has come to favor conservative scientific study of heredity in man we may have a usable science of eugenics which can be taught —possibly through some such conservative organization as our State college extension departments.

Unit Character in Man.

The teachings of Mendel, De Vries, and others have very greatly magnified the place which the unit character has in our consideration of problems of heredity. It is almost startling to think that the inhibitions responsible for honesty and dishonesty, morality and licentiousness, temperance and drunkenness, as well as strength of mind and defectiveness, talents for music, for poetry, for oratory, for mechanical invention, and the absence of these talents, may be even in a partial degree subject to the Mendelian laws of segregation, dominance, and recombination. The article by Doctor Goddard, of New Jersey, on page 165, reporting investigations into the heredity of feeble-mindedness, may be epoch-making in drawing the attention of Mendelian students to the importance of investigations of unit characters in man. This one line of investigation has proven to the Association the wisdom of inaugurating investigations in human heredity. "Facts are God's arguments." Facts so clear and so vitally important to the strength of mind and strength of purpose of the future race at once break down the feeling that these subjects might be made vulgar by investigation. The sunlight of fact cleanses and purifies every subject; and the normal mind is ever open to the truth. "And ye shall know the truth, and the truth shall make you free."

Wide Cooperation in Eugenics Desirable.

The almost unanimous vote of the members of the Association to raise the Committee on Eugenics to the dignity of a Eugenics Section encourages the officers of the Association to make more vigorous efforts to promote investigations along this line. Members of this Association and general readers of the *Magazine* are urged to secure members from among those interested in the subject of eugenics. And what intelligent person is not interested in heredity in man? The hope is arising that the Association may build up a very large section in its membership of persons who wish to encourage and assist the committees in promoting investigations along the line of eugenics. The officers are determined to guide the investigations along scientific lines. It is believed that the forthcoming discussion in the *Magazine* of heredity in man will be of interest to criminologists, physicians, teachers, and preachers, since these deal with the more intimate phases of the lives of men, and have especial need of a knowledge of heredity in man. It is easy to predict also that no other class will have a livelier interest in the discussions of heredity in man than

those who are technically interested in plant and animal breeding. Since the philosophy of animal breeding was first wrought out in a practical way the breeders of plants, adopting the philosophy of animal breeders, have in the past decade distanced animal breeders in the application of the philosophy to the technique of breeding. May it not be in the end that our students of heredity, rather than physicians, anthropologists, and humanitarians, will be most efficient in the development of the science of eugenics?

Funds are being provided by private parties to carry along work relating to heredity in man. Some public and semipublic institutions are also cooperating. There is no line in which private parties could better invest funds for public service. The laboratory established in London by Sir Francis Galton is doing a good work, and similar institutions are needed in all leading countries. Many new questions are coming up for solution, and the further the subject is developed, the more problems which seem open to solution, are presenting themselves.

Breeding as a School Subject.

The subjects of breeding plants and animals and heredity in general are passing from the stage of indefinite knowledge to a status of organized science. There is being rapidly wrought out a body of knowledge which is interesting, highly instructive, and even inspirational. This knowledge is of such a character that once it is presented in pedagogical form it will be very useful as a means of mental development. A comprehension of the laws of heredity and breeding and an intimate knowledge of many of the natural and artificial forms in which heredity manifests itself gives the mind scope to analyze facts of nature and economics. A knowledge of the philosophy, the processes, and the art of creative and practical breeding will ere long be regarded as a substantial part of culture in many college courses. But the large place which breeding will claim in schools will be in vocational courses. Men who are preparing to be technicians along plant and animal lines will demand graduate courses in natural and artificial evolution. Splendid collegiate courses in breeding will be developed for the student in agronomy, horticulture, forestry, and live-stock management. Studies on heredity in plants, animals, and men will be placed as culture studies in many general and technical courses, and especially in medical colleges.

The simple common-sense features will ere long be winnowed out of the chaff and straw. Separate text-books for secondary schools will deal with the more fundamental and practical laws and with the

methods of plant and animal introduction and creative breeding, the growing of pedigreed animals, seeds, and plants, and the dissemination of new and valuable varieties and breeds. The text-books for agricultural and other collegiate courses can be highly scientific and at the same time give comprehensive treatment to the methods of creative breeding, the production of pedigreed stock, and the principles of plant industry. Breeding is peculiarly a separate part of agronomy, horticulture, and live-stock management. That it relates most vitally to all three of these subjects gives it an unusual degree of importance, and the simpler elements may even find their way into the higher classes of the separate agricultural high school, or the high school classes of village and consolidated rural schools. This subject will continue to gain a more and more important place in such forms of college and department extension as correspondence courses, itinerant schools, farmers' institutes, and demonstration farming.

Our colleges of agriculture should begin to systematically build up divisions for instruction in breeding, that they may provide teachers of this subject for secondary schools. The first essential is to create a separate division, placing in it the best available man as leader and providing him with facilities and assistants as rapidly as he can use them to advantage. The colleges should also train men for the work of research and for creative breeding of plants and animals under public and private auspices. There is already starting a demand for men trained to be circuit superintendents in animal breeding, for men to guide associations for the cooperative ownership of males, cow testing associations, and other like institutions. Men are coming into demand to manage plant and animal breeding experiments and creative plant and animal breeding enterprises under national, State, cooperative, corporate, and private auspices. The demand for demonstrators, researchers, teachers, and practical breeders may come forward in this line of work as rapidly as classes of enterprises have demanded men in forestry during the last decade. Because this subject is larger, represents a several times larger interest, and involves a several times larger possible increase of income, it may afford employment to a larger number of technical men than even forestry does. Further, the work is even more technical and varied than forestry. The young men who are qualified by nature for this work and who will thoroughly equip themselves may hope for most enjoyable and profitable employment and may anticipate the satisfaction of having done a substantially large service.

A group of our strongest agricultural colleges, north and south, should push into the work of preparing men for the work of technical research in heredity and breeding. All States should begin to devise plans for the introduction of breeding as one of the required subjects in all secondary courses for farm youth. College extension departments should develop this subject so that it may be better presented through their various avenues for the giving of practical instruction to adult farmers.

Publishers have here a new field for profitable enterprise in getting out text-books suited to the various grades of schools. The field for the sale of manuals on breeding is also rapidly enlarging. Every five years the increase in knowledge along this line will warrant the issuance of new text-books and manuals to meet the needs of different grades of students and of the different classes of growers of plants and animals.

The experience of the officers of the American Breeders Association warrants the statement that recent developments in the science of heredity and breeding, and the developments in prospect in the near future, are revolutionizing the thought and methods in breeding throughout the world. The Mendelian study of heredity first aroused plant breeding from its position trailing far behind the work of animal improvement. And now the self-complacent animal breeders, having begun to realize that plant improvement has recently chased past them, are awakening from the sleep they entered upon soon after Charles Darwin had given them an awakening half a century ago. It was by chance that the present writer was for more than a decade practically the only American specialist who was working in both fields of animal and plant breeding. It has been an interesting experience to see plant breeding arouse itself from a position far in the rear, and push forward until it is now leading animal breeding into new scientific methods.

The bringing together in the American Breeders Association of the plant breeders and the animal breeders, as well as the scientists interested in heredity of the two organic kingdoms, was a result of the accident of the writer's dual interest, which led him to observe that, since the laws of heredity are mainly common to both kingdoms, each could assist the other. It is true that the earlier plant breeders have received the basic elements of their philosophy from the animal breeders. But it is also true that later the plant men are more than

paying the debt in the philosophies of the subject, and especially in working out many elements of practice.

Mendel, De Vries, Neilson, Burbank, Williams, Fairchild, Zavitz, and others have devised methods of experimentation, of creative breeding, and of introduction and distribution which are full of suggestions to those who improve our large farm animals, fowls, pet stock, and also the semi-domesticated and wild meat and fur animals and wild birds.

The science of heredity and the practice of creative breeding may be said to have a parallelism to the science and practice of aviation investigation. Langley bore somewhat the same relation to the new developments in the aeroplane that Mendel did to statistical records of heredity. De Vries would pronounce the achievements of both mutations. Count Zeppelin has isolated a pure race of dirigible balloons of prodigious size, evidently of a type designed for military purposes. Breeding has had no such literary character as Darius Green with his flying machine. Burbank and the Wright brothers are contemporaneous; McDougal with his saline solution evidently crossed the English Channel separating the inorganic from the organic impulses, and may have produced variations by environmental stimulus applied to the ovule at the moment of marrying the pollen grain.

While this seems a digression from the subject, the great mutating plants and animals must not be neglected in a statement concerning the development of education along the lines of breeding. Messenger, the father of the American driving horse; the original tree from which sprang the Wealthy apple; the potato seed from which came the Burbank potato; and other mutants, will stand along with the theoretic truth brought forward by De Vries. Vilmorin's monumental work with the sugar beet, in instituting centgener breeding, now spreading throughout plant and animal breeding all over the world, will long head a leading chapter in books on practical breeding.

The opportunities for brilliant achievements have not all been embraced. The cream of this subject has by no means been all skimmed off. Not only in research but in the pedagogics of the subject is there room for many brilliant careers. The science of heredity and breeding is so comprehensive, so complex and extensive that there is scope for the brightest minds. The economic goal is so large that society can well afford to devote to research and creative breeding the talents of large numbers of its brightest sons.—W. M. Hays.

News and Notes

Increasing Weight of Fleeces.

The Bureau of Statistics of the Department of Agriculture has recorded the average weight of wool fleeces each year since 1891 (except in 1892); within this period the average weight has increased from 4.9 pounds per fleece in 1891 to 6.8 pounds in 1909, an increase of 38.8 per cent. In 1910 the average weight is 6.7 pounds. The steadiness of the increase is shown in the following table of the weight per fleece in each year:

Year.	Pounds.	Year.	Pounds.	Year.	Pounds.	Year.	Pounds.
1891	4.9	1897	5.8	1902	6.3	1907	6.7
1893	5.3	1898	5.8	1903	6.1	1908	6.6
1894	5.4	1899	5.9	1904	6.4	1909	6.8
1895	5.6	1900	6.2	1905	6.6	1910	6.7
1896	5.7	1901	6.2	1906	6.7		

The production of wool per sheep as recorded in the last decennial census was 6.7 pounds in 1900 (the average of the fleeces, exclusive of those obtained in the fall shearing of 1899), 5.6 pounds in 1890, and 4.8 pounds in 1880. The census returns for 1850 and 1860 were defective, but indicate approximate yields of 2.75 pounds in 1850 and 2.96 pounds in 1860. From these data it appears that the production of wool per sheep has increased about 150 per cent from 1850 to 1910.

It is interesting to observe that a similar improvement in the breed of sheep for wool has taken place in Australia. The official Yearbook of New South Wales for 1907-8 states: "Of late years considerable attention has been given to the question of breeding, and the result is seen in the great improvement in the weight of fleeces." The average weight of wool per fleece in New South Wales (which contains more than half of the sheep of Australia) in 1881-1885 was 5.24 pounds; in 1886-1890, 5.42 pounds; 1891-1895, 6.41 pounds; 1896-1900, 6.71 pounds; 1901-1905, 7.61 pounds; 1906-1907, 7.82 pounds.

It appears from the figures above that in these two great sheep-growing countries improvement in breed and in the care of flocks has within the last twenty years increased the average weight per fleece more than 35 per cent.—NAT. C. MURRAY.

Unrewarded Merit.

The world continues to erect piles of enduring stone to immortalize the military hero and the statesman. The "man on horseback" has at all times, and in all countries, occupied a prominent place as decoration in parks and squares. On the other hand, a feeling is more recently arising that the real builders of our civilization have received comparatively little attention. The men who broke the prairies, cleared the forests, built up the world's commerce; who contributed to culture, education and art; who gave us books, labor-saving machinery and all the conveniences and luxuries of modern buildings, have all received too little credit. And especially has the race neglected its mothers, great and small, who have nursed into being the agencies and the builders that have made our civilization possible.

It is worth while to raise the question as to whether we have shown due appreciation to those who have domesticated plants and animals and to those who have created new forms of life useful to man. One may truly be pardoned for the rashness of proposing a monument to the creature, troglodyte or human, who for the first time rubbed out the scanty diococcum heads, placed the grains in a skin or bag and stowed it away in cave or hut, guarding it against rodents or thieves and carrying it over to the next seeding season to grow another crop. This masterful interference with nature by a dawning intelligence may have occurred before the discovery of the use of fire and even of articulate speech. However this may have been, that genius was the first farmer in history and also the first plant breeder. And, by the way, there is excellent reason for the belief that that first farmer was a women. But passing that and approaching more recent times, one might speak of those enthusiasts, each in his day, who labored, hoped and probably starved to realize the desire that burned within his soul to give the world a fruit, a cereal, or a flower better adapted, suited to more uses, and more profitable than any that preceded it.

Take, for instance, Ephraim Bull, who gave to the world the Concord grape, now a standard variety, cultivated in thousands of vineyards, found in nearly every section where grapes will grow. He created wealth, luxury, refreshment, and food for millions. His work is today precisely as valuable as it was on the day he first gave it to the world. That first mother-vine which thrives to this day at Concord, Mass., has multiplied its potency into the tens of millions of vines, unchanged, not losing one iota from any one of the many qualities which gave it its peculiar value. Ephraim Bull died in poverty. Late in life, just before the end, kind neighbors befriended him, but their assistance came too late. Bull not only deserved a pension while he lived but a monument after his death—he never received either.

The story of how Peter Gideon, the originator of the Wealthy apple, spent his last few dollars—against the advice and will of his wife at that—for a quantity of apple seed is widely known. One of these thousands of seedlings which grew from those seeds was the mutation he had sought and hoped for. Just one. But that one was worth all the privation and waiting and patience. Its "blood" has multiplied thousand upon thousand fold, still unchanged, still the same heredity. In the course of the years it has earned millions of dollars for the farmers of the Northwest. It is now fast becoming a prominent apple in all cold countries. Peter Gideon deserves a monument. These are only two instances among many.

We have strayed far in our argument, but it was necessary to lead up to the conclusion. It is the purpose of the American Breeders Association to make a permanent collection of portraits, with short biographical sketches, of all persons who have done either creative work in the art of breeding, or notable work in the science of breeding and heredity. These portraits of breeders and scientists, both living and dead, will be continued as a permanent feature of the *Magazine*. With the help of the membership, which is fairly cosmopolitan, the editors should be enabled to build up a most interesting iconography of breeders the world over.

There are workers in all countries who have plodded and many perhaps without reward. Let us learn their names, what they have done, and if possible how they have done their work. For example, members in Japan, the country where plant breeders and gardeners have wedded nature and art with rare skill, many have knowledge of some of the geniuses who have originated some of the plant creations peculiar to that country.

Let us if possible find the men, and record their work, who were early identified with the breeding of the Percheron horse in France and the Clydesdale and the Shire horse in England; also the breeders of Rambouillets in France and Spain and of the wonderful array of excellent breeds of sheep in England; the meritorious breeders of all breeds of cattle wherever found; also breeders of flowers and vegetables and horticultural crops. The world may not, for a long time to come, accord these patient, unselfish workers the credit that is due them. But an association composed of men and women who understand, who deal with and who know the economic and commercial side of heredity values, can very appropriately make its publications the archives for the preservation of records relating to men of note in the field of breeding, and honor them by giving recognition to their work and thus reward them even if only in a small degree for their services to humanity. And the lives of men now living, especially the older, will also serve as themes for doing justice to useful service. It is most pleasant to tell a man while yet living of the good he has done, and often a man's own neighbors need to see the work of their fellow citizen from the viewpoint of the State or Nation. Few who have really performed services as creative breeders have been overestimated. Many, like Mendel, have been sadly forgotten.

Private Game Preserves Beneficial.

An article concerning private game preserves, by the Hon. J. T. Holland, Game Commissioner of Colorado, in the *Amateur Sportsman*, New York, July, 1910, is of interest for the reason that Mr. Holland believes that the office of State game warden should be removed from politics. He asserts that "our game is fast disappearing and chiefly because, no one having an interest in the game belonging to the public exclusively, there is a tendency for every one to get all he can while it lasts."

The Colorado system of licensed game preserves and licensed lakes is warmly advocated, because "experience has shown that it is far better to attempt any legitimate traffic in game than to attempt to license all sale and traffic and thus compel persons who are not in

position to take their game but insist upon having it, to assist the game hunter in his unlawful depredations upon all varieties of game animals."

It is stated that "a single preserve alone will recommend a very great many sportsmen to our State, who, were it not for the game preserves, would necessarily go out on the range and take their share of the game belonging to the public at large. Probably the greatest advantage of the system of game and fish preserves is that this system more perhaps than anything else has tended to wipe out the market hunter of Colorado; another advantage is the taking of game in preserves by owners thereof results in leaving very much of the game on the public range for others and the regulation of the selling and shipping of game which is permitted under the laws of our State permits the people to have this desirable food," and it is Mr. Holland's opinion that "the more and the larger the game preserves, the better. A national law is advocated, as such is essential in order to do justice to each of the States, as it cannot be expected that one State will pass laws prohibiting the killing of (certain) birds within its borders while persons in adjoining States can kill them; consequently in order to be fair to all concerned a national law should be passed fixing the open seasons so that the States would all be on the same basis and each would have an equal show at the game."

The paper concludes with the statement that "fish raising and selling in Colorado has come to be a much larger industry than game raising and selling. We have in the State dozens and dozens of what are known as licensed lakes, which are conducted along the same lines as game preserves and when properly conducted are very profitable to the owners. Many of the owners of these lakes are shipping fish constantly to the markets of our State and of other States, and still through the high degree of perfection which has been attained in fish culture the sum total of our fish in Colorado to-day in all probability is far greater than it was ten years ago."

Whatever objection may be uttered against the private game preserves, there is this in their favor, that they are more likely to encourage scientific and systematic breeding of game animals than public preserves.

Dark-Skinned Animals in the Tropics.

In a recent letter to the Secretary of the Association, Dr. Charles E. Woodruff, lieutenant-colonel in the Medical Corps of the U. S. Army, Cebu, P. I., calls attention to the fact that the breeds of domestic animals which have been produced in tropical climates have heavy black pigment in the skin, whatever may be the color of their hair, while breeds produced in the cloudy, cooler regions of northeastern Europe often have light-colored skins. He also calls attention to the fact that some of these light-skinned breeds do not do well when taken into warm sunshiny countries. He says, "The lethal effect of excessive amounts of light is harmful to all kinds of protoplasm, whether it is in a bacterium or in a hog." He quotes Prof. Robert Wallace of Edinburgh University as stating that all domestic mammals originating in the tropics have black skins.

Doctor Woodruff says, "I find that every native horse here has a black skin, no matter what its hair color—there being few albinos." These horses are of Chinese stock, and other stock does not do well there. Doctor Woodruff has long been contending that one reason why people with light complexion do not do well in warmer climates is that the sun's rays too readily penetrate through the light-colored skin. He has long argued also that tuberculosis patients accustomed to northern cloudy and cool climatic conditions are not benefited by removal to hot climates where there is much sunshine. He now suggests that this may also be true in case of cattle and that many northern cattle will not be able well to resist tuberculosis in many of the tropical and subtropical regions because of the additional amount of sunlight.

The problem of introducing domestic animals from one climate to a radically different climate is most important. Colonel Woodruff has demonstrated that this subject of light-complexioned races of men and of animals should be studied extensively. There can be no question of the wisdom of studying the problems connected with introducing breeds of animals which by centuries of natural breeding have become resistant to a disease into regions to which that disease has recently migrated, as in case of the Indian cattle in our Southern States. And the making of hybrid breeds which retain the excellence of two or more constituent breeds may prove worthy not only of thorough research but of much experimental demonstration.

Wild Prototypes of Wheat and Other Cereals in Palestine.

Until quite recently, wheat has been classed among those plants whose genealogy has been lost in the long space of time during which it has been cultivated by man; and this belief was quite generally accepted even among scientists. The report of A. Aaronsohn, director of the Jewish Experiment Station of Haifa, Palestine, that he had discovered the wild progenitor of wheat is therefore of decided historical interest. (Bulletin 180, Bureau of Plant Industry, U. S. Department of Agriculture.)

The type which Doctor Aaronsohn regards as a wild form of wheat is the *Triticum dicoccum dicoccoides*—the wild emmer found in Palestine and Syria. On the occasion of a visit to the Jewish agricultural colony at Rosh Pinar this wild Triticum was discovered, resulting in the find of only one plant. A later visit to Mt. Hermon revealed large tracts of this wild Triticum at an altitude of more than 9,400 feet. Its most interesting feature is its extreme variability. The forms found were so numerous that no attempt at determination could be made.

The author rejects the idea that this Triticum had escaped from cultivation and gives as a reason the facts that it is not cultivated in Syria or Palestine at present and that it is found only upon slopes of the most arid and rocky hills and in places most exposed to the sun. Another significant observation is that a form of wild barley seemed to be habitually associated with this wild emmer. This explains the curious fact that in ancient literature, and even in excavations made in Egypt, seeds of these two plants are almost always found together. This would indicate that the cultivation of the two grains took place simultaneously and that neither of these grains was cultivated first. This wild emmer and barley growing so abundantly on large tracts would naturally attract the attention of nomadic or local tribes, and its domestication and cultivation was a natural consequence.

Variation and Correlation in Timothy.

In Bulletin 279 from the Laboratory of Experimental Plant Breeding, Cornell University, Ithaca, N. Y. (48 pages), several interesting illustrations accompany the text. In this technical bulletin is worked out a statistical study of the variations and correlations of the principal characters of the timothy plant. The observations cover a population of 3,505 plants and extend over a period of three years.

ASSOCIATION MATTERS

Committee Members.

A circular letter has been sent out by the office of the Secretary making the appointments to the various committees and requesting the respective committee chairmen to communicate with the committee members as to the preparation of reports for the coming meeting in February. It is to be hoped that the committee members, practically all of whom continue from last year, will carry on their work along lines mapped out in previous years. Committee chairmen should, with the help of their committee members, block out new work for two or more years ahead, so that work which requires research, correspondence, or collection of statistics may be planned with definite ends in view. Committees on breeding gladioli, sweet peas, and dahlias are in process of organization, but are not sufficiently far along to allow announcement of full membership. It would be well to obtain from committee members, as well as from non-members, titles of papers or addresses to be presented at the meeting at Columbus or for the *Magazine*.

Eugenics Section: Its Organization.

A small folder issued by the Eugenics Record Office, describes the work and organization of the Eugenics Section and is here quoted in part:

This comprises the interests of the Association that relate to human improvement by a better selection of marriage mates and the control of the reproduction of the defective classes. Its officers are David Starr Jordan, chairman, and C. B. Davenport, Cold Spring Harbor, Long Island, N. Y., secretary. With them have been associated well-known students of heredity and humanists, among others Alexander Graham Bell, Washington, D. C.; Luther Burbank, Santa Rosa, Cal.; W. E. Castle, Harvard University; C. R. Henderson, University of Chicago; Adolf Meyer, Johns Hopkins University; J. Arthur Thomson, University of Aberdeen; H. J. Webber, Cornell University; Frederick A. Woods, Harvard Medical School.

The work of the section is two-fold, that of the Eugenics Record Office and that of the committees.

The Eugenics Record Office, located at Cold Spring Harbor, Long Island, N. Y., is under the general direction of the secretary of the section and has as its superintendent Prof. H. H. Laughlin. The record office seeks to accumulate and study the records of physical and mental characteristics of human families and to educate the public as to classes of fit and unfit marriages. Its work is done by means of (a) correspondence, (b) the acquisition of family records on special blanks, and (c) the inquiries of field workers investigating either in conjunction with institutions or independently.

The committees serve as centers for special inquiries or for education. They are of two sorts, (a) technical committees and (b) local committees. Technical committees are composed of professional men trained for special inquiries. They further investigations in their subjects and advise the record office. Their composition changes from time to time. Those already organized, with their present personnel, are as follows:

Committee on Heredity of the Feeble-Minded: A. C. Rogers, chairman; H. H. Goddard, Vineland, N. J., secretary; J. C. Carson, H. H. Donaldson, Walter E. Fernald, J. M. Murdock.

Committee on Heredity of Insanity: Adolf Meyer, chairman; E. E. Southard, Harvard Medical School, Boston, Mass., secretary; August Hoch, F. A. Woods.

Committee on Heredity of Epilepsy: W. N. Buliard, chairman; Everett Flood, Palmer, Mass., secretary; J. F. Munson, E. E. Southard.

Committee on Heredity of Criminality: C. R. Henderson, chairmen; M. G. Schlapp, Cornell Medical School, New York City, secretary; W. M. Carmalt, William Healy.

Committee on Heredity of Deafmutism: Alexander Graham Bell, chairman.

Other committees are being organized.

The local committees are to serve as local centers for collection and study of data and for education. It is contemplated that such committees will be formed in connection with various universities and at other intellectual centers.

The Eugenics Section seeks to cooperate with all existing agencies for the same work. It invites correspondence of persons interested in the subject of eugenics and willing to collaborate.